AUTOMOTIVE and Aviation INDUSTRIES

OCTOBER 1, 1944

Two Hundred Million New Departure Ball Bearings In This War!

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Such an unprecedented demand is an accurate index of ball bearing efficiency in carrying the loads, maintaining precise location of moving parts, reducing friction and wear.

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NEW DEPARTURE
BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS CORPORATION • BRISTOL, CONNECTICUT

Sales Branches: DETROIT, G. M. Bldg., *Trinity 2-4700* • CHICAGO, 230 N. Michigan Ave., *State 5454* • LOS ANGELES, 5035 Gifford Ave., *Kimball 7161*

LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATI
OCT 12 1944

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Not a minute of extra "record keeping"

MANY SYSTEMS for saving time and labor require so much clerical work and record keeping that the "cure" they offer is often worse than the "ill." This is not true of Standard's Coded Lubrication Service. Once installed, this system requires no record keeping. It automatically tells your oilers *where* lubricant is needed and *what* lubricant to use on every spot to be lubricated in your plant.

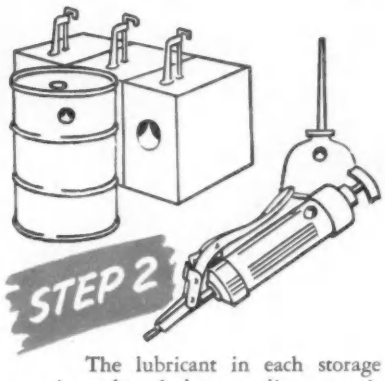
These three simple steps, described at right, show how easy it is to apply this system or adapt it to your present plan.

With this system installed, oiler crews simply fill their grease guns, oil cans, or other dispensing equipment with the right lubricant, by number, and apply it to the machines by number. In addition, if you feel that it is necessary to tell the oiler *how much* lubricant is needed, and *how often* to apply it, machine record cards are available on which this information can be entered. The most important problem, however, of getting the *right lubricant* in the *right place* every time is solved in the three simple steps outlined.

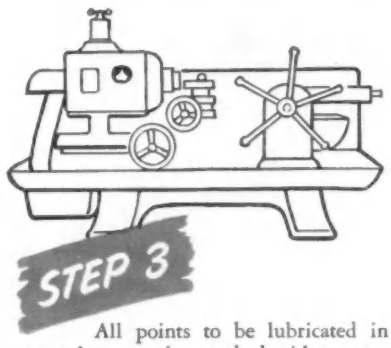
A Standard Oil Industrial Service Representative will be glad to show you samples of the decals and the lubrication chart. He will be glad to talk with you or your men in charge of lubrication about putting this system to work in your plant. Call the nearest Standard Oil Company (Indiana) office, or write 910 South Michigan Avenue, Chicago 80, Illinois, for a Representative. In Nebraska, write Standard Oil Company of Nebraska at Omaha 2.

How Standard Coded Lubrication Service is applied

Each lubricant used in your plant is assigned a number. These numbers are recorded on a lubrication chart—this is the only record making that is ever needed—and copies are kept in the oil room, purchasing department files, or wherever else they may be useful.



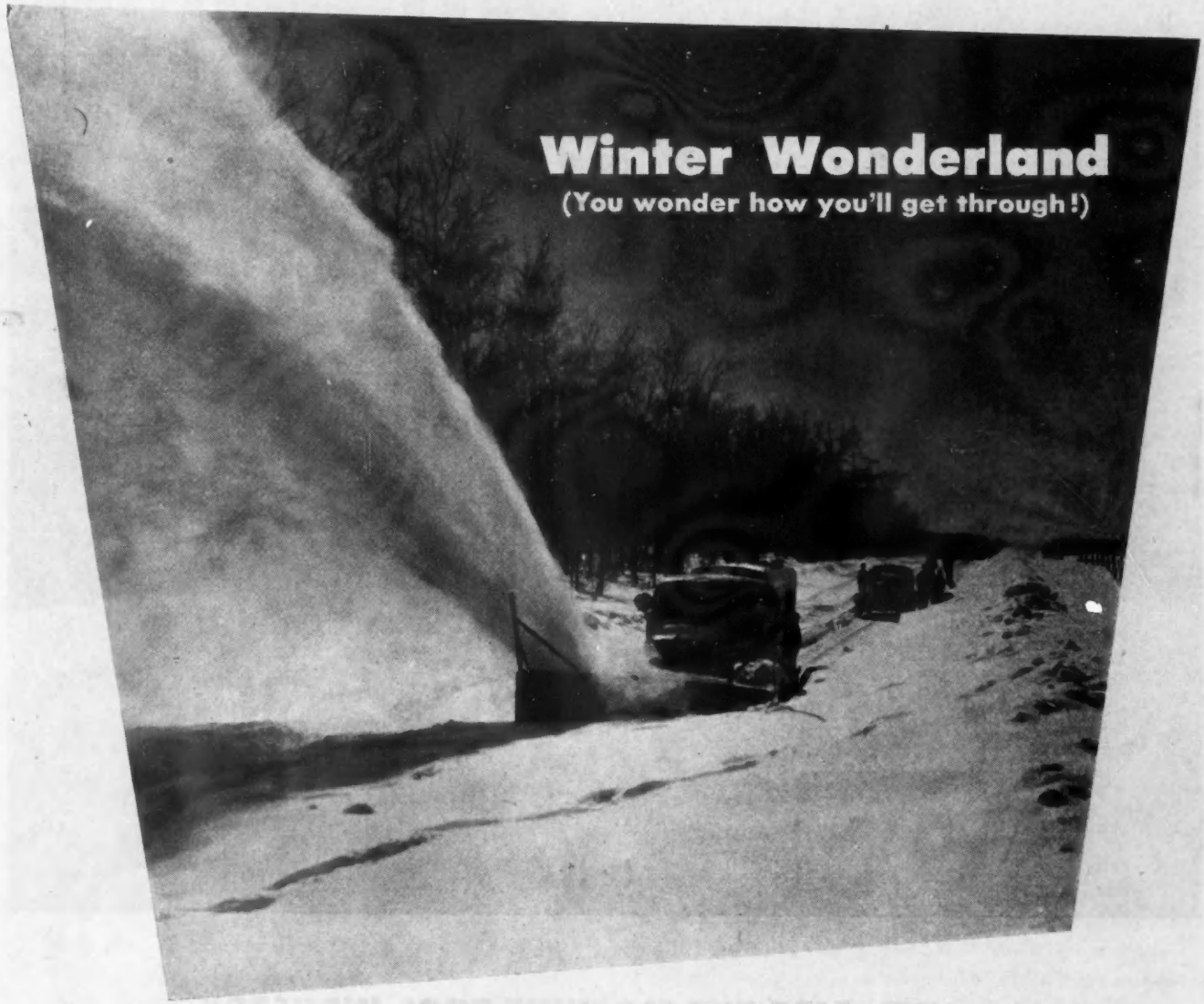
The lubricant in each storage container—barrel, drum or dispenser—is identified by the number assigned to it. Numbered decals, in two color combinations, are used for this purpose—another example of the simplicity of the system.



All points to be lubricated in your plant are also marked with a numbered decal indicating *what* lubricant is to be used, and *where* it is needed.

Gasoline Powers the Attack... Don't Waste a Drop!

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE



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PRECISION-BUILT • SPECIALLY ENGINEERED FOR YOUR PRODUCT

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to KEEP 'EM WORKING!

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Unfaltering performance is demanded of these leviathans of the prime mover family under extreme battle and temperature conditions. Young Heat Transfer engineers developed and manufacture the engine jacket water cooling radiators and lube oil coolers which must function efficiently even when the front air-intake doors are closed and airflow is restricted. In fact, Young engineers assisted in the design of the complete engine cooling system, including the development of fan specifications. Let Young Engineers apply their specialized training to your heat transfer problems.

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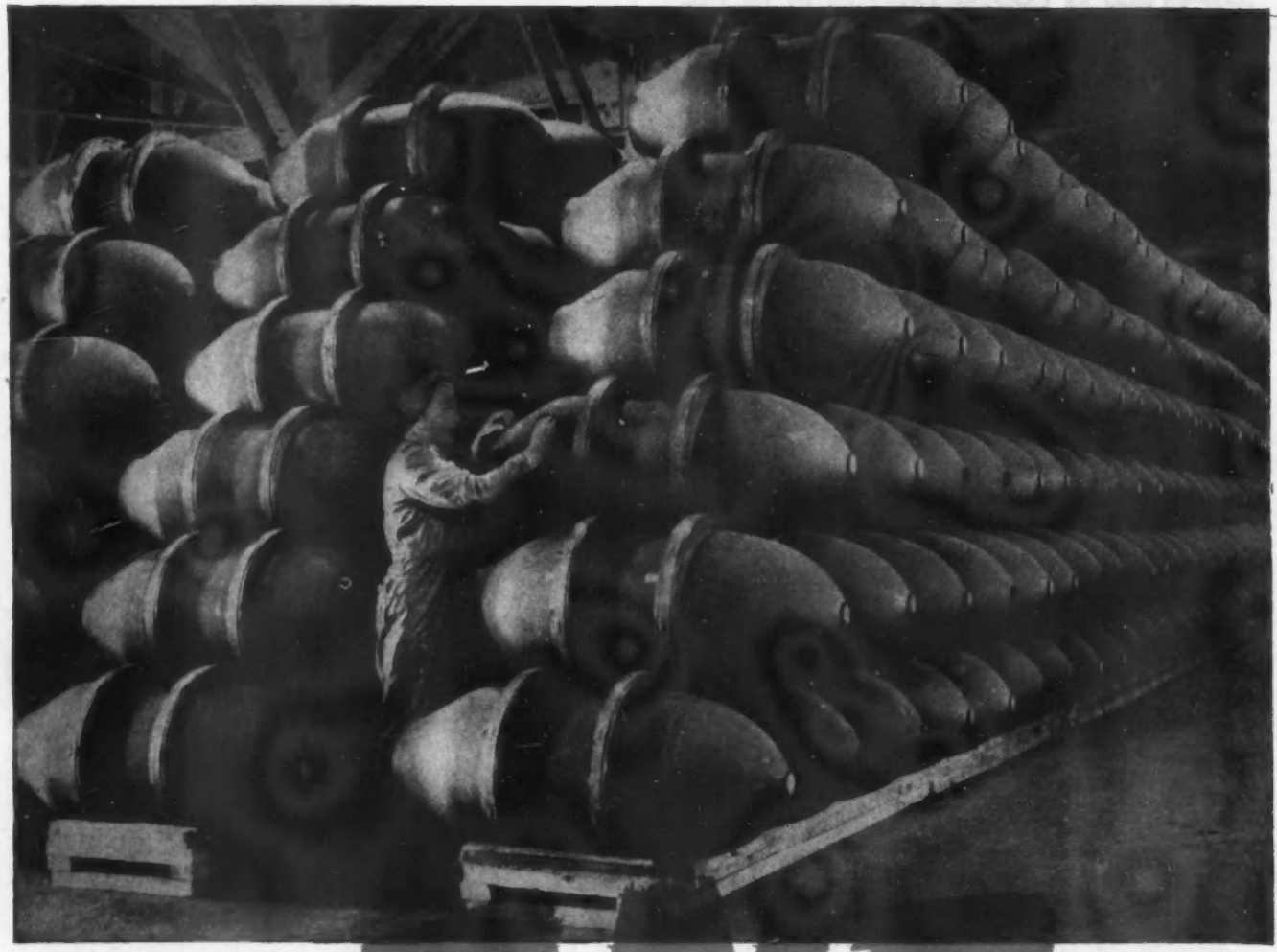

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POWERFUL TNT, for which endless rows of bomb cases are waiting, looks and pours in a thick, yellow stream . . . a deadly, 1000-lb. "yolk" for each of these bomber "eggs".

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Texaco lubricants have proved so effective in service they are definitely preferred in many fields, a few of which are listed at the right.

The services of a Texaco Engineer, specializing in cutting coolants, are available to you through more than 2300 Texaco distributing points in the 48 States. The Texas Company, 135 East 42nd Street, New York 17, N. Y.

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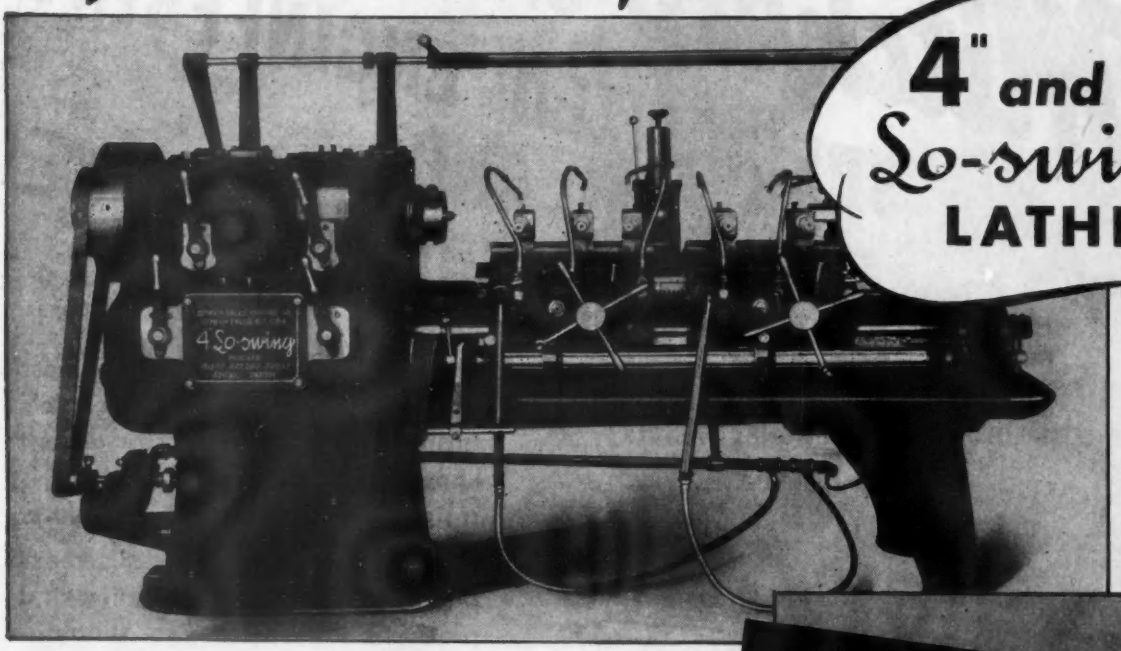
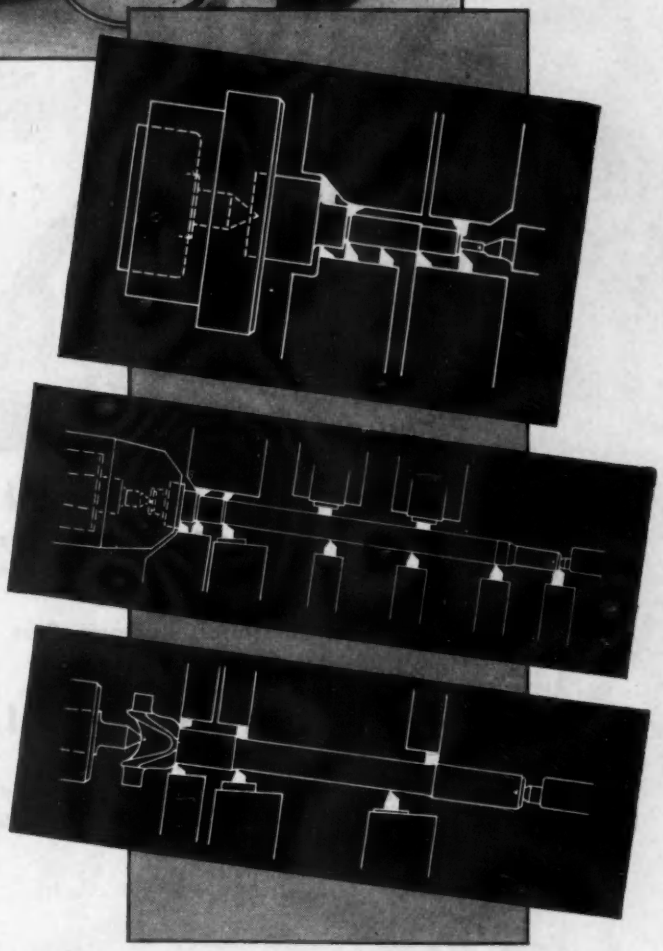
A PROVEN SHAFT TURNING MACHINE

For the small plant



4" and 8" Lo-swing LATHES



● If you have shaft or similar work to turn, in small lots, this proven multiple-tool lathe will help solve your problems. It has an enviable record for accurate, low-cost production.

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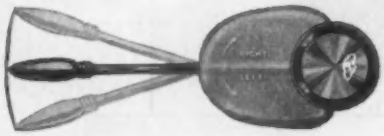
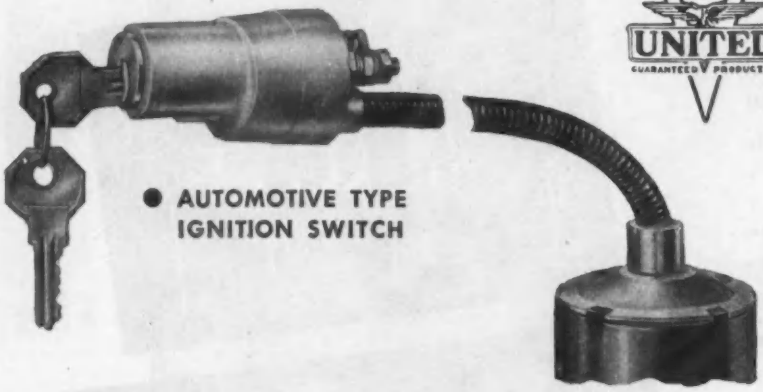
SWITCHES FOR SEMI-AUTOMATIC DIRECTIONAL SIGNALS

● *CLAMP-ON TYPE*





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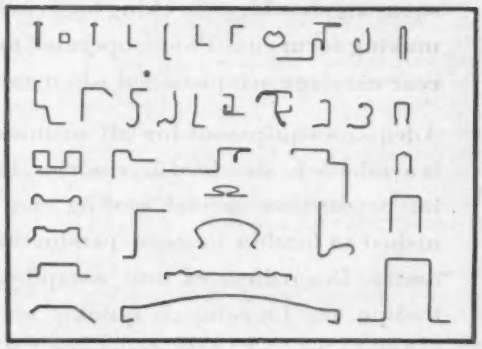

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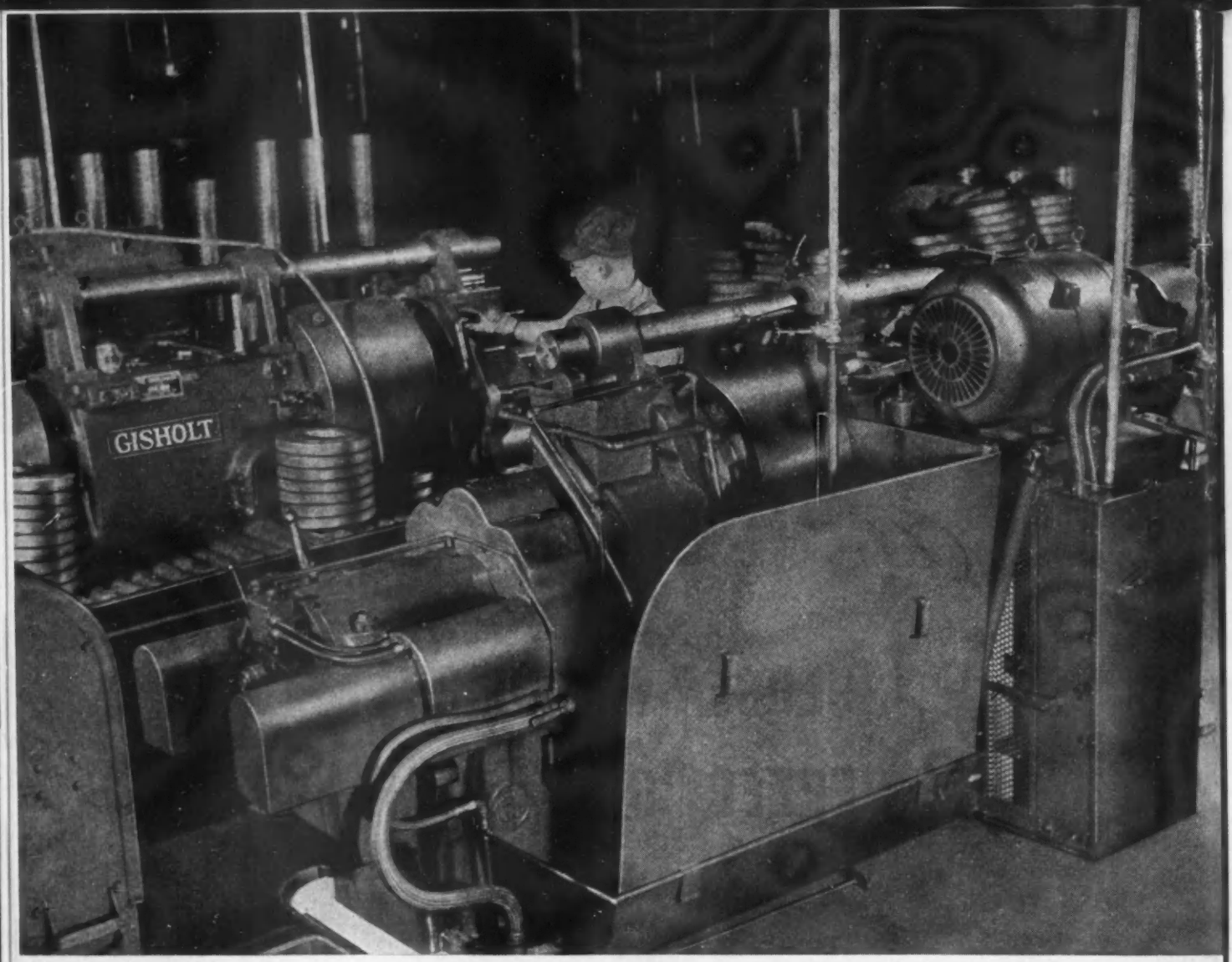

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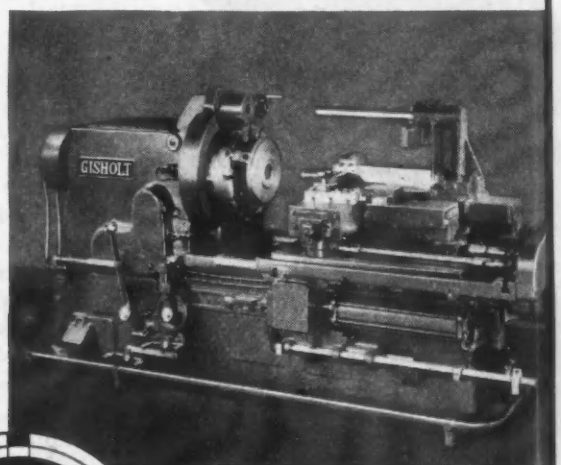

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firsts BY

$H=I^2RTK$

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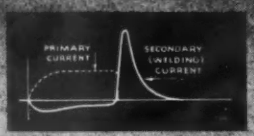
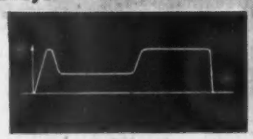
first WITH STORED ENERGY



First introduced in 1939 . . . Sciaky electro-magnetic Stored Energy principle found immediate acceptance in the aircraft industry. Special Preheating current, together with the Dynatrol arcless current interruptor are employed . . . the most efficient process for welding light alloys.

first WITH VARIABLE PRESSURE



An automatic pressure cycle essential for heavier gauges of aluminum . . . metal is precompressed, then pressure reduced during weld, followed by forging pressure after the passage of current . . . accounts for metallurgically sound welds. Cycle also used for forging on a.c. machines for steel.

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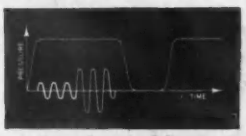

An exclusive Sciaky process for the welding of scaly and rusty steels . . . produces welds equal in consistency, uniformity and structure to those usually produced on clean pickled steels. Results in excellent tip life . . . permits comparatively rapid welding times for heavy stock.

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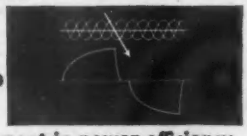

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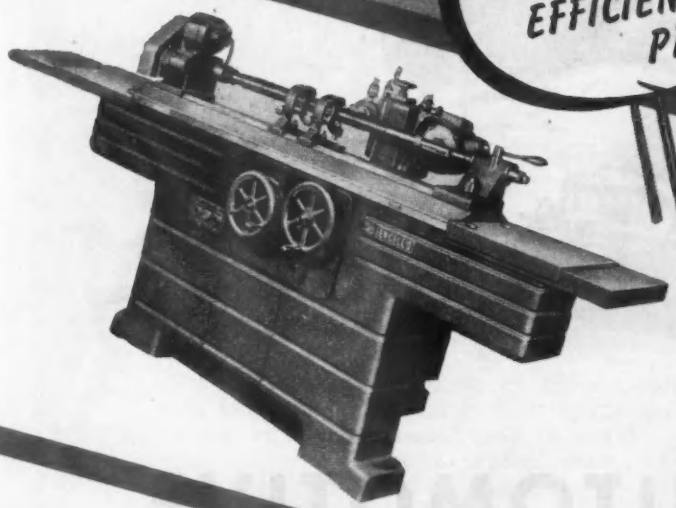

EX-CELL-O—STYLE 80

For economical sharpening of round broaches. Has heavy base and sturdy, well-supported table. EX-CELL-O precision ball bearing spindle assures freedom from vibration, maximum service life, and a good grinding finish. V-belts and 3-step pulleys allow a practical range of work speeds. Push button controls are on front of the machine.

EX-CELL-O—STYLE 81-L

For sharpening flat broaches and grinding straight slots, keyways, and grooves to close tolerances. The cross travel of the spindle is manually operated. Adjustable stops are provided so that spindle travel in either direction can be accurately limited when necessary. Ex-Cell-O broach sharpening machines have been in use in Ex-Cell-O plants.

*M*ANY years of experience in the production of broaches, broaching fixtures, and precision machine tools form the background for the design and manufacture of Ex-Cell-O broach sharpening machines. Each machine is built to give the utmost in speed, accuracy, and economical production. Each combines simplicity and ruggedness in construction, with modern streamlined appearance. These new Ex-Cell-O broach sharpening machines are special purpose machines. They are ideal for large production set-ups, and are advantageous also for occasional work. By the use of Ex-Cell-O broach sharpening machines, set-up time is highly minimized, the hazard in changing equipment is practically eliminated.

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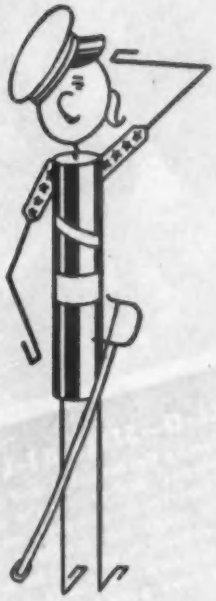

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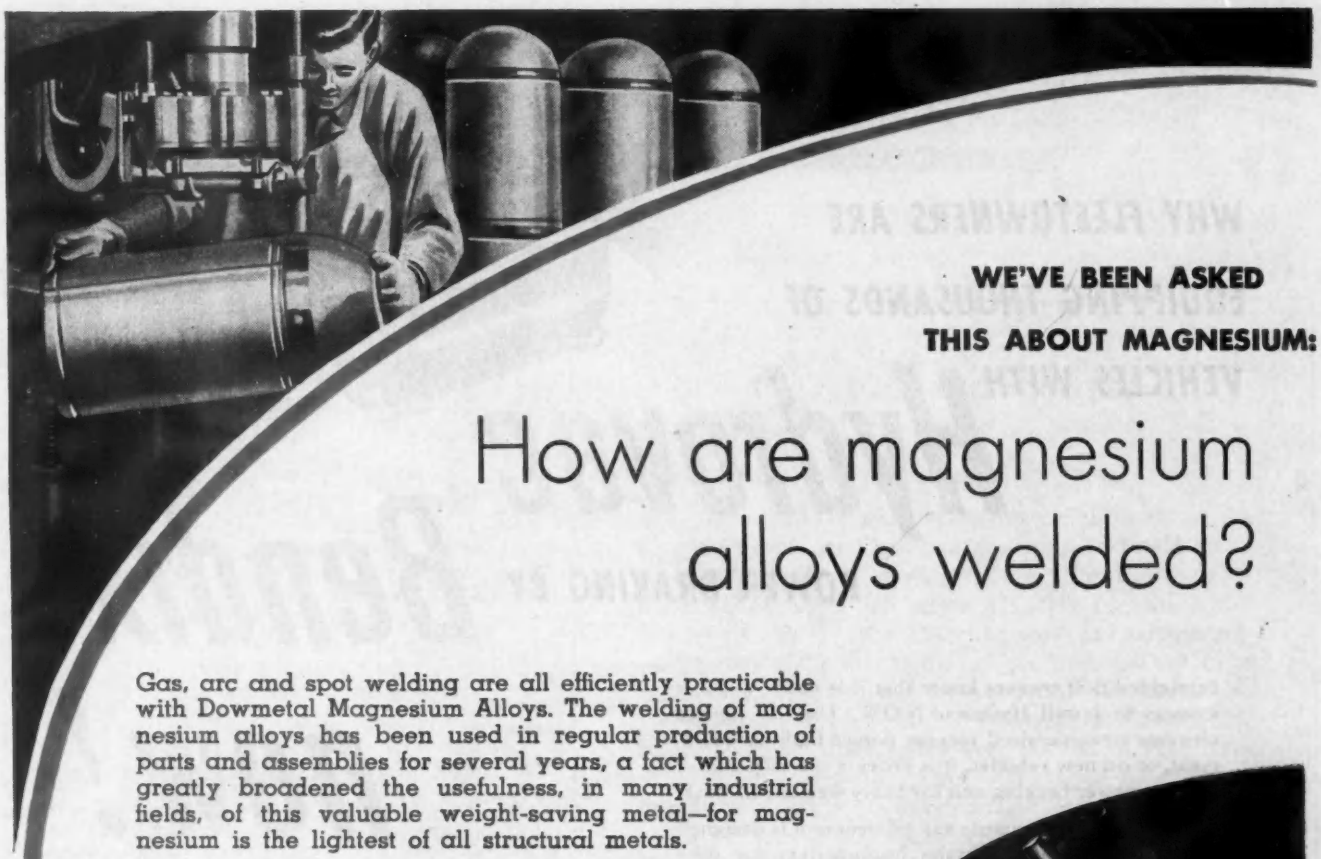

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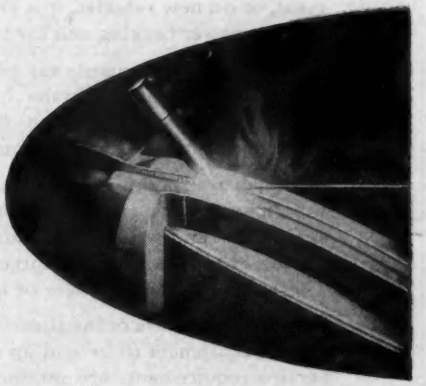
How are magnesium alloys welded?

Gas, arc and spot welding are all efficiently practicable with Dowmetal Magnesium Alloys. The welding of magnesium alloys has been used in regular production of parts and assemblies for several years, a fact which has greatly broadened the usefulness, in many industrial fields, of this valuable weight-saving metal—for magnesium is the lightest of all structural metals.



Any good welder can join magnesium alloys as readily as he can other metals. *Gas welding* is well adapted to the making of butt welds; fluxes are available for this type of weld. In *arc welding* (illustrated at the right) a tungsten electrode is used, and the weld area is shielded from air by a screen of inert gas, such as helium or argon, thus eliminating the need of fluxes. Lap, butt, edge and fillet welds can be made by this method. Magnesium alloys can readily be *spot welded* to each other. Less current density is required because of the lower electrical conductivity of magnesium alloys in comparison with aluminum. Clean metal and clean electrodes will insure a better spot weld.

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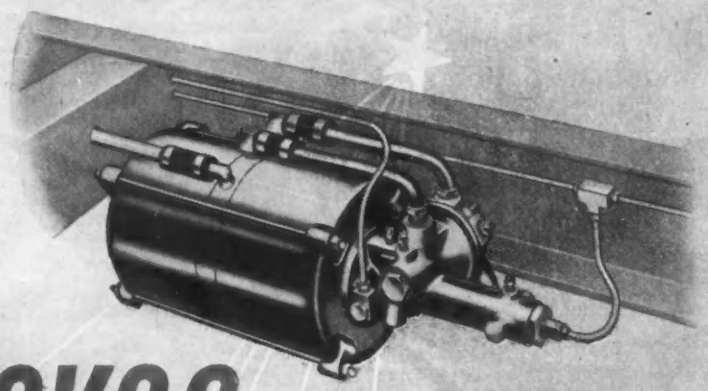

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This outstandingly simple and efficient unit is designed and built by Bendix—brake headquarters for over thirty years—and proved on the "world's toughest proving ground"—the warfronts of the entire world.

The Hydrovac braking unit is a triumph of engineering simplicity. It is one compact unit completely enclosed against dirt and water. It is readily installed anywhere on the chassis, with only three tubing connections. There are no external levers or links.

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If you own or service hauling equipment, now is the time to look into Hydrovac power braking. It is the answer to today's braking problems, and will remain the outstanding development for years to come. See your Bendix B-K dealer or write the factory direct.

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IN THIS ISSUE . . . .

AUTOMOTIVE and AVIATION INDUSTRIES

Volume 91 October 1, 1944 Number 7

National Metal Congress 17

In Cleveland, from the sixteenth of October to the twentieth, there will be presented the most ambitious program ever undertaken by the American Society for Metals, at the 26th annual National Metal Congress. Here is an outline of what is being arranged. Read it and see that it will be well worth the time to be present. Big things are happening in this field.

Poppet Valve Train Design 18

In this article there is a lot of data derived from recent research projects. Keep posted, keep up to date, read it.

1500 Production Machines On Allison Engine Parts 24

Five years ago the Cadillac Division of General Motors began its program of producing precision parts for the Allison engine. Not alone from the size of the job taken on, but from the equipment that is being used, unprecedented accomplishments have been achieved. You will find the whole story told with thoroughness in text and illustrations.

Salvage of Damaged Parts Of Airframes 31

There have been acceptable methods of salvaging parts of airframes that have been damaged in manufacture. Here are several pages of specified repairs as compiled by the Engineering Committee of the Aircraft War Production Council.

Gyropilots in Quantity Production 38

With war entering into the program of American endeavors the production of Sperry Gyropilots presented new problems. The Electric Auto-Lite Co. did a big job. Its major contribution was the development from scratch of job lot production methods in keeping with the volume required and in training a force of unskilled labor. It is interesting and instructive.

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

Our Federal Courts

By Julian Chase

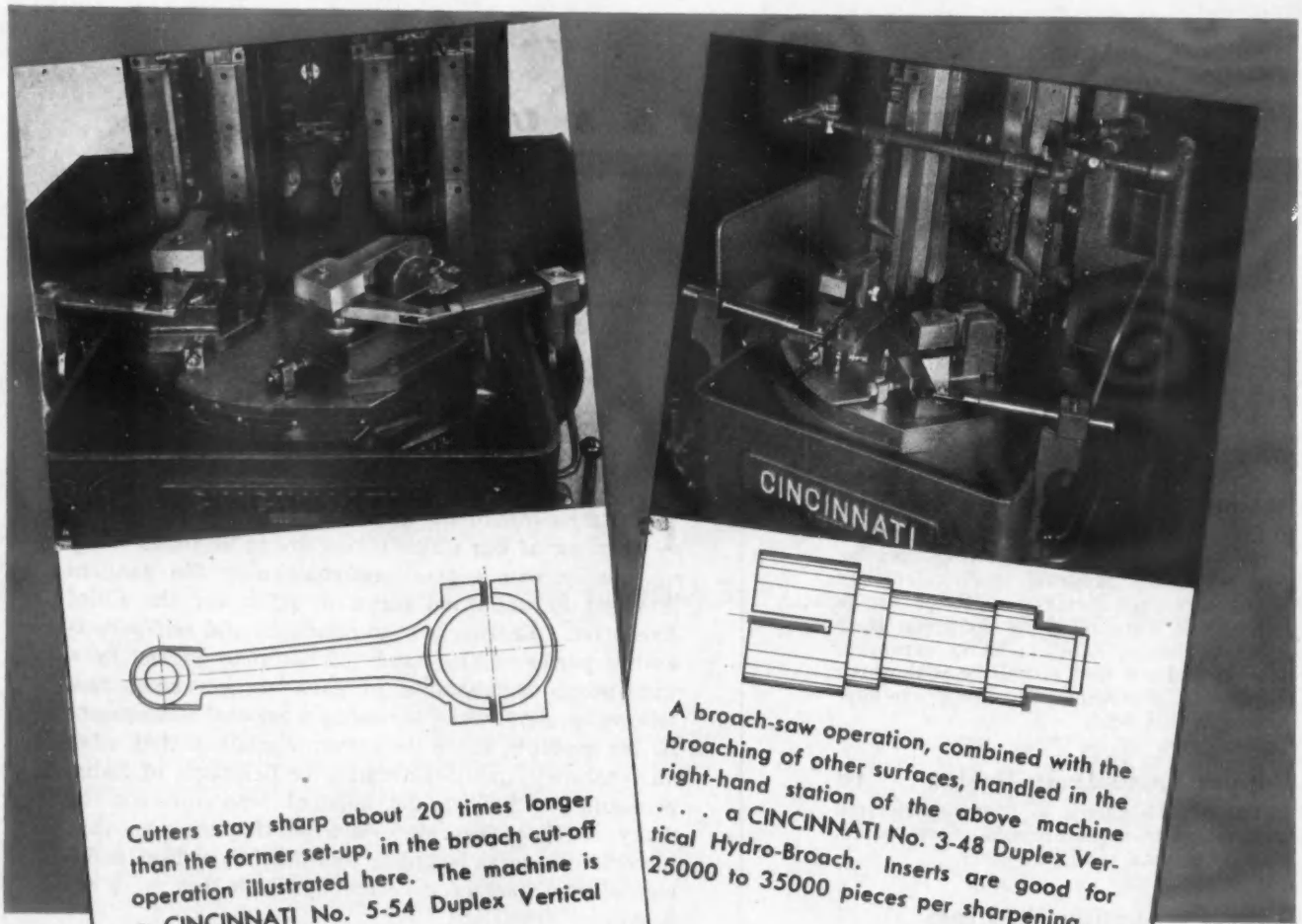
IN THE records of the discussions which preceded the framing of our Constitution are to be found many profoundly wise expressions concerning the dangers inherent in unlimited terms of office for the Chief Executive. Entrenched, accumulated and self-perpetuating power in the hands of one man backed by a widespread organization of parasitic henchmen and fellow-travelers, was visioned as a natural consequence if, for example, there were ever elected to that office an insatiably ambitious man with delusions of indispensability. Such a development was foreseen by many of the great statesmen participating in that historic debate as complete nullification of the fundamental principles of government which they were endeavoring to vitalize.

For 150 years no President served more than two terms or permitted himself to be considered as a candidate for that office after a second term. Now we have the possibility of a President's having been continuously in office for 16 years. If he stopped or were stopped then, his peculiar theories, philosophy and concept of political morality would continue for a long period as largely controlling influences over the lives and activities of our people through flavored judgments of our federal courts which, up to his time, had been maintained in a fair state of political balance.

Of our Supreme Court Justices, 78 per cent; of our Courts of Appeal Judges, 74 per cent; and of our District Court Judges, 61 per cent are appointees of our present President. The overall percentage is 65. In four years more it might possibly reach 100. Only three or four of the more than 150 appointees during the past 12 years have not been rated as New Dealers.

Judging by the President's expressed and implied attitude toward the courts and by his obvious preference in his selection of appointees for men about whom he can feel that "your mind and my mind go along together," it would seem unlikely that any other than fellow-traveler appointments would be made in whatever time or at whatever opportunities there may turn out to be for making them.

There is little of more importance to the country than the maintenance of a non-partisan judiciary. There is still time to save some part of our federal judicial system from complete New Deal domination.

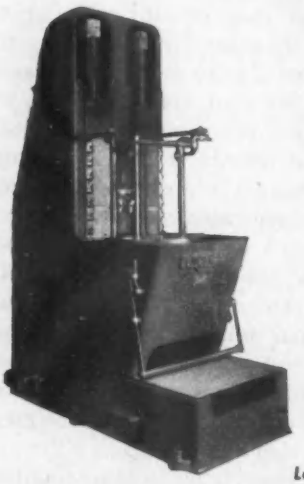


Cutters stay sharp about 20 times longer than the former set-up, in the broach cut-off operation illustrated here. The machine is a CINCINNATI No. 5-54 Duplex Vertical Hydro-Broach.

A broach-saw operation, combined with the broaching of other surfaces, handled in the right-hand station of the above machine . . . a CINCINNATI No. 3-48 Duplex Vertical Hydro-Broach. Inserts are good for 25000 to 35000 pieces per sharpening.

PERHAPS YOU CAN USE

THIS *"Broach-Saw"* TECHNIQUE



Formerly one of the most difficult operations on surface broaching machines, the broaching of narrow saw slots has been perfected by CINCINNATI Application Engineers to the point of a routine production job. Two examples are illustrated here . . . a cut-off operation, and a "broach-saw" job combined with the broaching of other surfaces.

Does this suggest a more economical method in your own shop. Operations of this type on CINCINNATI Hydro-Broach Machines show amazing economies. Remember, too, that *close accuracy* can be maintained; that a *reasonably good finish* will be produced and an excellent finish can be obtained with properly designed tools. Our engineers will be glad to discuss all phases of surface broaching with you, and show you how CINCINNATI Hydro-Broach machines will fit into your production lines.

Left—CINCINNATI No. 5-42 Duplex Vertical Hydro-Broach Machine. Complete specifications may be obtained by writing for catalog M-894-2.

CINCINNATI

THE CINCINNATI MILLING MACHINE CO. CINCINNATI, 9 OHIO, U.S.A.

TOOL ROOM AND MANUFACTURING MILLING MACHINES . . . SURFACE BROACHING MACHINES . . . CUTTER SHARPENING MACHINES

AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st and 15th of the month

October 1, 1944
Volume 91, No. 7

Hundreds of Exhibits at National Metal Congress

Extensive Technical Programs Arranged for Meetings of Five Societies at Cleveland, October 16-20

ONE of the most ambitious programs undertaken by the American Society for Metals is the 26th Annual National Metal Congress combined with War Conference Displays in Cleveland's Convention Hall, Oct. 16-20. In addition to the technical sessions planned by the ASM, the Congress will include a comprehensive schedule of meetings by the American Welding Society, American Industrial Radium and X-Ray Society, Iron and Steel and Institute of Metals divisions of the American Institute of Mining and Metallurgical Engineers, and the Society for Experimental Stress Analysis.

Convention Hall exhibits, at this writing, include an impressive group of some 370. Among the exhibitors are producers of basic materials, manufacturers of industrial equipment for heat treatment and processing, manufacturers of instruments and tools, producers of X-Ray equipment and supplies, manufacturers of plastic molding machinery, welding machines and welding electrodes and supplies, suppliers of cutting fluids of various types, testing machines, materials handling equipment, machine tools, etc.

The exhibits are designed to provide an impressive picture of current developments and possibly postwar developments in many fields of vital interest to metallurgists, chemists, research workers, engineers, and production executives. Judging by past experience the technical men of the automotive industry will find their visit to Cleveland well worthwhile and productive of ideas that can be translated into practical use during reconversion.

Generally speaking, these men will be able to acquire an essential background on the latest developments in many related fields. Among these are the following: welding, in all its branches—resistance welding, arc welding, oxy-acetylene torch welding; induction heating and induction hardening; heat treating; metal cleaning; metal cutting-tools, machinery, cutting fluids; metals—steels, non-ferrous metals; industrial X-Ray and Radium equipment and test methods; chemicals; plastics—basic materials and machinery for molding; physical and chemical laboratory materials, testing equipment and instruments; instruments for research and production applications; materials handling equipment; metal cleaning methods; grinding, polishing, and buffing equipment; fastenings; etc.

The ASM has arranged a program of group discussion meetings in which there will be panel discussion led by well-known experts in each field. It is of interest to find that a good percentage of these sessions will be devoted to various phases of quality control, including one on statistical methods. Although the details of the technical programs of the participating Societies are too extensive for treatment here, we give below a topical reference for each of the societies:

American Society for Metals:

Surface Hardening
Hardenability
Non-Ferrous Metals
Physical Properties
Aluminum and Magnesium Alloys
Melting and Special Alloys
Tool Steel
Radiography and Testing
Chromium and Molybdenum Alloys

(*Turn to page* 54, *please*)

Recent Research in

Poppet

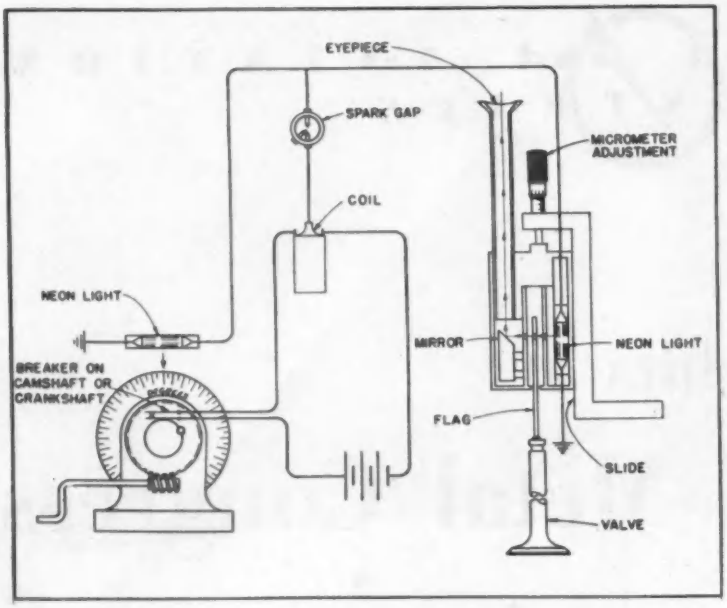


Fig. 1—Arrangement of components for stroborometer used for measuring the position of a valve at a selected position of a cam.

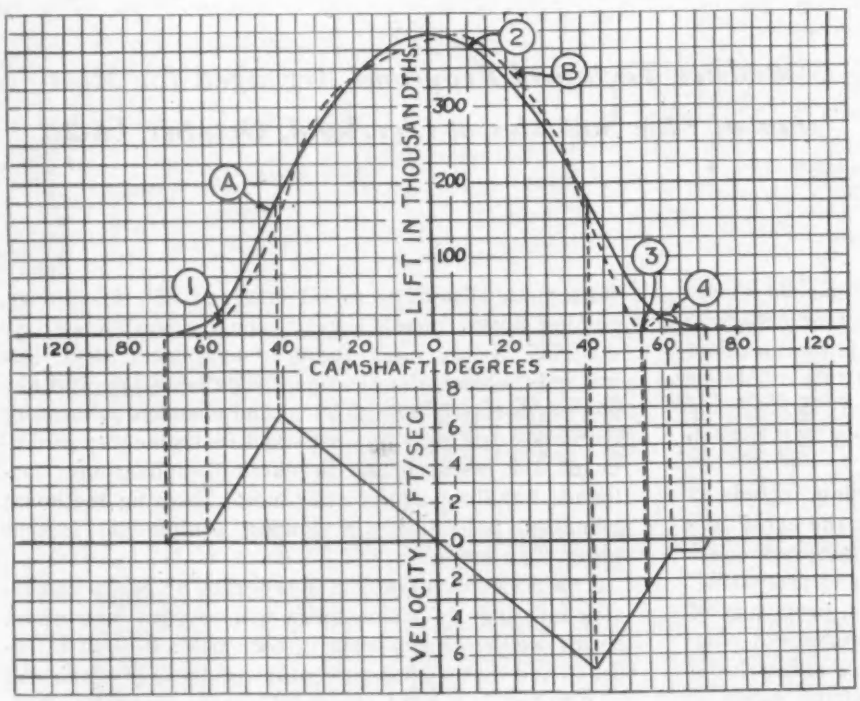


Fig. 2—Actual valve motion curve obtained with the stroborometer.

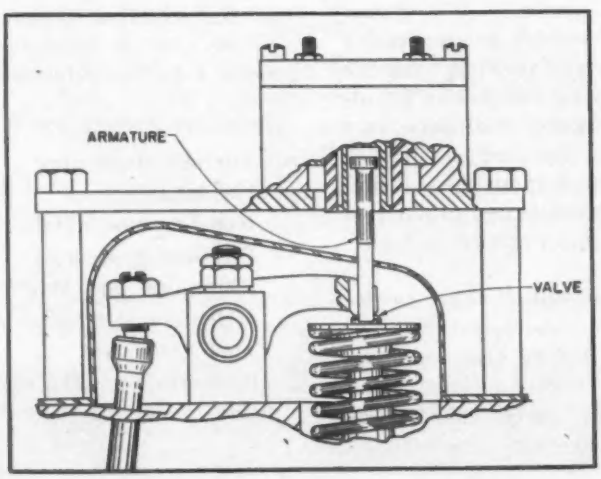


Fig. 3—The pick-up, here mounted on an overhead valve, translates valve motion into electric potential which can be viewed on the oscillograph screen.

THE usual problem confronting powerplant engineers is to provide as much power as possible with a torque curve suited to the particular application of the engine, to consider the durability of all parts involved, and maintain quietness of operation to a degree consistent with the application of the engine. It is obvious that the valve train must be suited specifically to the type of engine and the kind of service to which it is applied.

Valve Train Design by Trial-And-Error Method.

In the initial design of an engine, the objective is to provide ample breathing capacity for the combustion chamber and a timing suited to the power requirements. However, in the final analysis it is still necessary to determine the timing and valve lift, as well as other factors involved in valve gear design, by the trial - and - error method. As a result of the inability to predetermine the requirements of a specified engine with respect to the valve train, it is necessary to begin with a set of conditions based upon some calculation and previous experience, which it is believed will produce somewhat the required results. Best results are then obtained

By Carl Voorhies
Wilcox-Rich Division,
Eaton Manufacturing Co.

Valve Train Design

by determining various characteristics of the existing valve train and making the necessary corrections to fit it to the specific requirements.

After determining that the initial valve opening areas are sufficient, the problem becomes one of valve opening and closing speeds without failure of parts, and then what timing is best suited to the requirements of the particular engine and its application. Accepted methods of handling such calculations as valve spring requirements in connection with the valve train have not taken into consideration all of the factors involved. It so happens that every piece of a valve train is a "spring" within itself; whereas the usual method of calculation accepts only the valve spring, and all other parts are assumed to be rigid or infinitesimal in their effect upon the ultimate results. For this reason, the results in a given valve train setup cannot be predicted until studied in an actual engine installation running as nearly as possible under operation conditions. Text fixtures are of little use in studying a specific valve train. Even a dynamometer hook-up to motorize a camshaft affects the results, in many cases preventing the development of some breakage or failure in the test installation which would occur in actual service or vice versa. These limitations make it necessary to study the valve train motion at all speeds, with various conditions of clearance, and with available changes in each individual part.

Valve Train Deflection

While the major cause of faulty motion in most valve trains is excessive total deflection, it appears possible to build a valve train with some parts excessively rigid so that shock loading becomes a major factor, and that possibly the only part in the valve train which does not fail is the one which has just been heavied up. A correctly designed valve train must be of balanced design with no point of major deflection and with no part excessively rigid. However, the usual problem is one of excessive deflection and the remainder of this article deals with engines of this type.

In the study of valve train motion, the deflection of the valve train must be taken into consideration in deciding whether the performance is good or bad, as determined by oscillograph study of the valve motion. The reason is that shock loading increases with rigidity, and a deviation from the theoretical

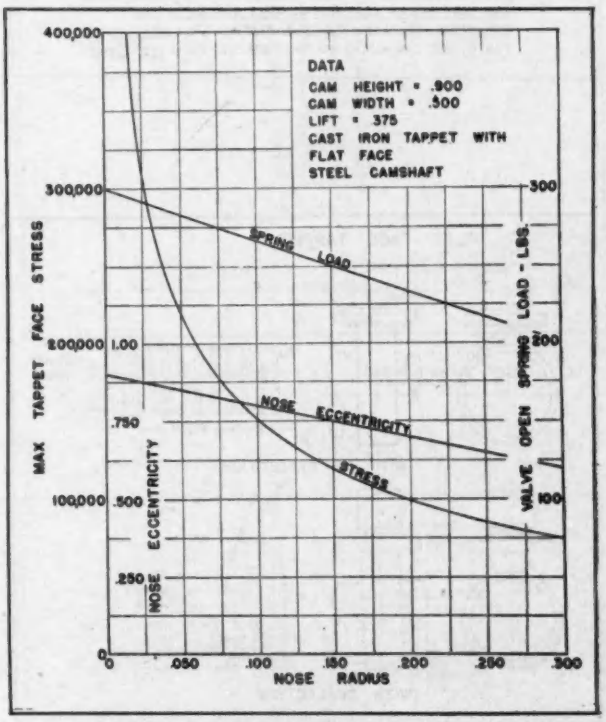


Fig. 4—This graph shows the stress change for a given cam as the nose radius changes.

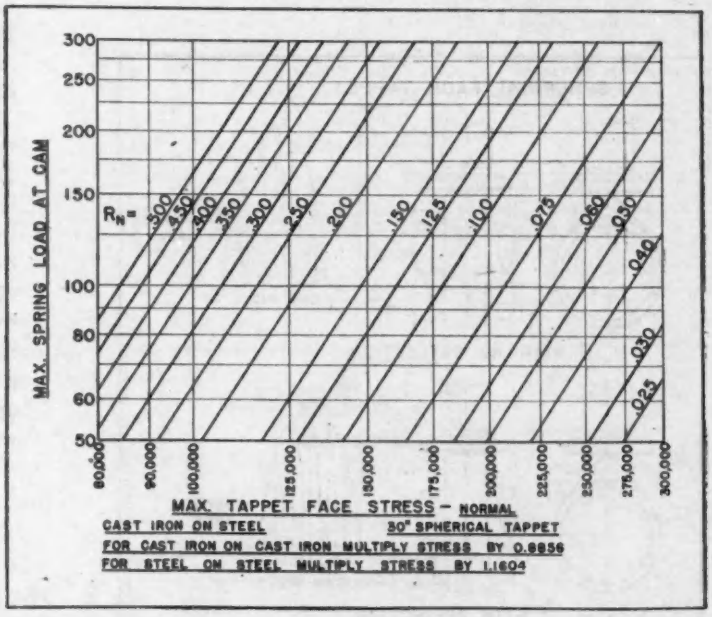

MAX. SPRING LOAD AT CAM
MAX. TAPPET FACE STRESS - NORMAL
CAST IRON ON STEEL
30° SPHERICAL TAPPET
FOR CAST IRON ON CAST IRON MULTIPLY STRESS BY 0.8856
FOR STEEL ON STEEL MULTIPLY STRESS BY 1.1604

Fig. 5—Chart for determining cam nose stresses where the cam contacts a 30 in. spherical tappet.

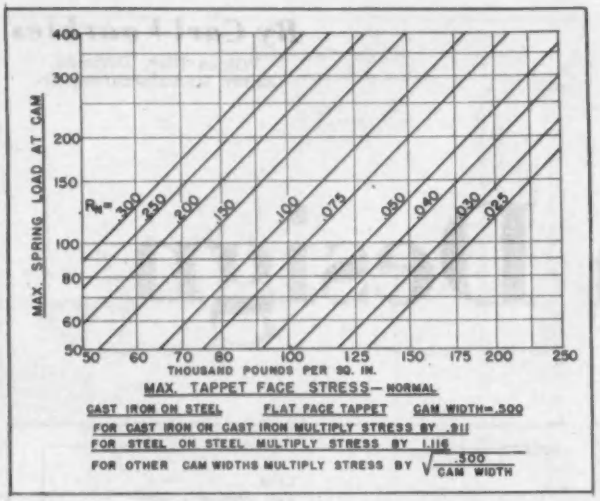


Fig. 6—Chart for determining cam nose stresses where the cam contacts a flat face tappet.

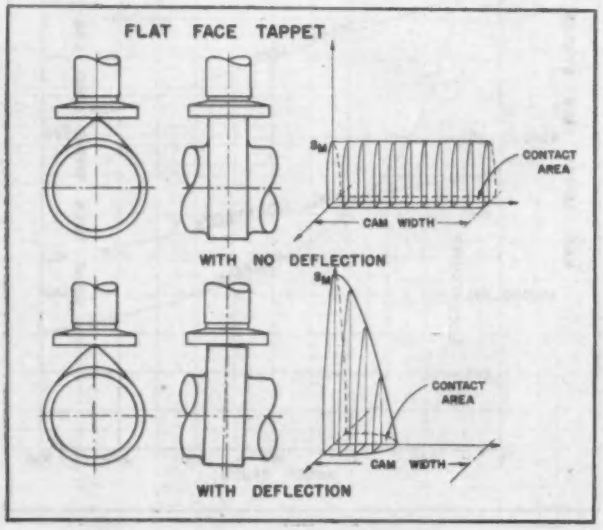
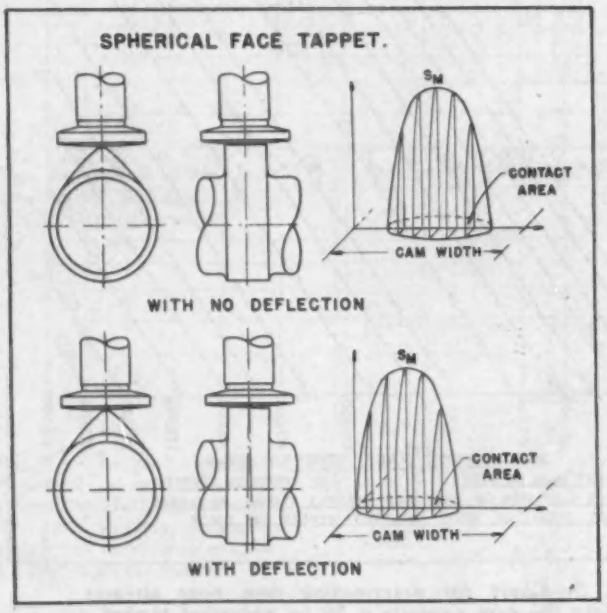


Fig. 7—With a flat face tappet the actual and theoretical stresses differ as a result of misalignment or deflection.



in the motion of a valve train having a considerable amount of deflection might be satisfactory with respect to failure of parts. On the other hand, the same departure from the theoretical motion in a more rigid valve gear might break valves, springs, or rocker arms, or cause failure of cams, or followers. Therefore, we cannot look at a photograph of the motion of a given valve train and say that it is good or bad, without knowing the relative departure of a similar valve train, or comparing the conditions under which failure occurs.

By making a study of the motion throughout the speed range certain characteristics of the false motion may indicate what can be done to improve the condition. By trying various combinations of minor factors which produce a gain, an improvement may often be made through an intensive study of any given valve train. All of this does not mean that calculations may not be used nor that they do not indicate possible means of improvement.

In an engine where maximum power is desired it is necessary to run the valve acceleration as high as possible and in some cases to hold the valve event shorter for a given lift than is consistent with smooth operation; i.e., the closer we can go to the maximum performance of the valve train, with respect to rapid opening and closing, and still retain reasonable fidelity of motion, the better the performance of the engine will be. A certain amount of false motion has to be accepted at maximum speeds. So long as this does not exceed the point where power loss or structural failure of the valve train parts occur, it should not be considered as unacceptable, especially since the acceleration should be as high as possible. If serious false motion is produced, the engine will have faulty performance and will break various parts of the valve train. On the other hand, if the design is such that practically no false motion exists, then the best possible performance has not been obtained from the engine.

Two engine speeds should be considered in connection with false motion. (1) The maximum speed at which the engine is to be normally operated, and (2) the maximum over-speed which the engine may reach under any circumstances. Power characteristics and quietness should be considered up to the maximum operating speed; consideration should be given to the over-speed only to the extent that parts should not break when the engine is operated for fairly short periods under over-speed conditions. If the valves are opened and closed as rapidly as possible, at a timing which produces best performance up to the maximum

Fig. 8—With a spherical face tappet the stresses are the same with deflection as without, assuming full contact.

operating speed, without structural failure at overspeed, the valve train may be said to be operating to best advantage.

Methods of Studying Valve Train Operation

The foregoing indicates that the first essential in making a study of the valve train is a valve motion study. Instruments for studying the valve train fall into four principal classes: (1) equipment which measures the lift of the valve at selected positions of the cam so that the path of the valve in motion may be plotted; (2) oscillograph equipment which produces a picture of the lift curve, velocity, and acceleration curve; (3) a strain gage which produces a graph indicating the loads on a selected part throughout the cycle, when used with an oscillograph; (4) high speed motion pictures.

The equipment which we have used for measuring the position of the valve at selected positions of the cam is a stroborometer (Fig. 1), so named because it uses a micrometer in conjunction with a stroboscope. A thin metal flag moves up and down inside a housing which has a micrometer adjustment for height, and which contains a neon light source which passes light through slots in either side of the chamber in which the flag operates. The light is always blocked off except at the instant when the slot in the valve flag is aligned with the two slots in the housing.

A graduated disc and current breaker are coupled to the camshaft, and by means of a small hand-crank the breaker point is rotated so that the light flash occurs at any desired degree on the graduated disc. Therefore, when a flash occurs at the disc, a corresponding flash occurs in the neon light at the valve. As the valve may be at any point in its cycle, the slots in the housing are adjusted up or down by the micrometer until the light passes through all three slots. The reading on the micrometer is recorded, and corresponds to the degree reading on the disc. The breaker point is adjusted to a new degree, which causes the light to flash at a new point, and this will require a new adjustment of the micrometer. By repeating the procedure for each degree on the cam contour, the actual motion of the valve is recorded in thousandths of an inch. Therefore, by obtaining a slow speed curve and then a high speed curve, the actual amount of deviation can be observed.

An actual valve motion curve obtained with the stroborometer is shown in Fig. 2. Curve A is the theoretical or slow speed curve taken at about 600 rpm, which also corresponds to the original lift curve design. Increasing the speed of the engine to 3000 rpm produced curve B. Thus, a valve motion curve has been obtained which is entirely quantitative, and the figures obtained from the stroborometer can be plotted to as large a scale as desired. These curves can now be analyzed and the amount of false motion occurring at any point in the cycle can be accurately determined. For example, the following determination can be made by this method: (1) The amount of delayed valve opening in degrees due to deflection; (2) the amount of erratic motion at full lift due to deflections or insufficient valve spring load; (3) the total deflections

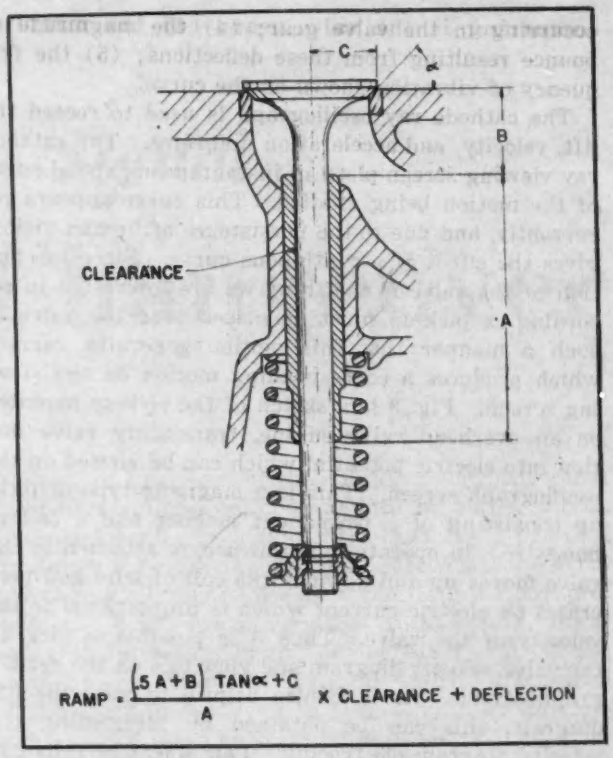


Fig. 9—Formula for calculating cam ramp.

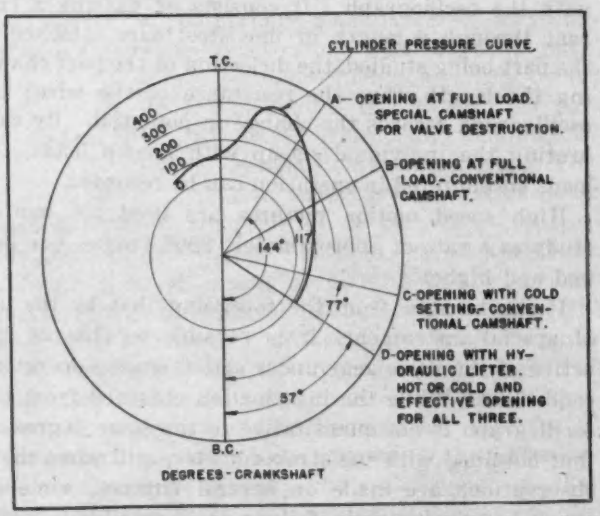


Fig. 10—An automotive engine radial timing diagram with superimposed cylinder pressure curve.

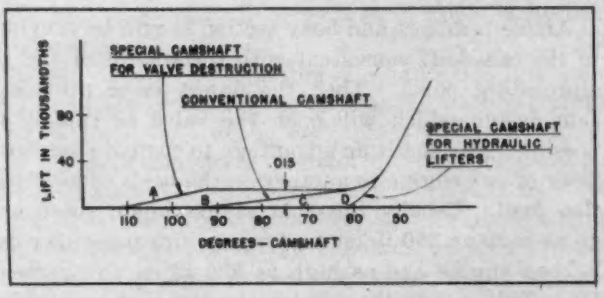


Fig. 11—Cam ramps for three types of application.

occurring in the valve gear; (4) the magnitude of bounce resulting from these deflections; (5) the frequency of vibration shown on the curve.

The cathode ray oscillograph is used to record the lift, velocity, and acceleration diagrams. The cathode ray viewing screen plots an instantaneous visual curve of the motion being studied. This curve appears recurrently, and due to the persistence of human vision, gives the effect of a continuous curve. Since the motion of the valve is the thing we are interested in recording, a pick-up must be placed over the valve in such a manner that this motion generates current which produces a corresponding motion on the viewing screen. Fig. 3 is a sketch of the pick-up mounted on an overhead valve engine, translating valve motion into electric potential which can be viewed on the oscillograph screen. This is a magnetic type of pick-up consisting of a permanent magnet and a coil of fine wire. In operation, the armature attached to the valve moves up and down in the coil of wire and generates an electric current which is proportional to the velocity of the valve. Thus it is possible to pick up the valve velocity diagram and view this on the oscillograph screen. As it is also helpful to view the lift diagram, this can be obtained by integrating the velocity diagram electrically. Permanent records can be made of these curves by setting a camera in front of the oscillograph and taking pictures of motions being observed.

The strain gage is another form of pick-up for use with the oscillograph. It consists of passing a current through a length of fine steel wire attached to the part being studied, the deflection of the part changing the length, thus the resistance of the wire; the oscillograph records the change in potential. By calibrating the individual set-up with known loads, the loads encountered in operation can be recorded.

High speed motion pictures are used for motion study at a rate of approximately 2000 frames per second and higher.

It can be seen from the foregoing that by the use of special instruments it is possible to observe the action of the valve gear under actual engine operating conditions. While the information obtained from the oscillograph is not quantitative to the same degree as that obtained with the stroborometer, still when these observations are made on several engines, some of which have valve train failure, it is possible to build up information that can be applied in such a manner as to obviate failures due to valve train false motion.

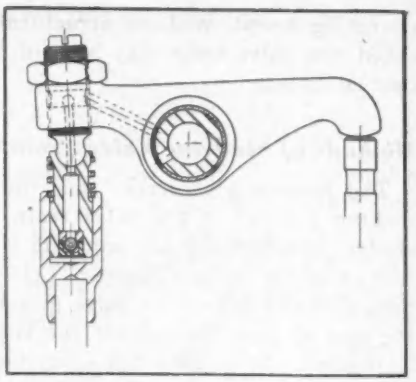


Fig. 12 — Experimental hydraulic valve lifter unit installed at top of push rod.

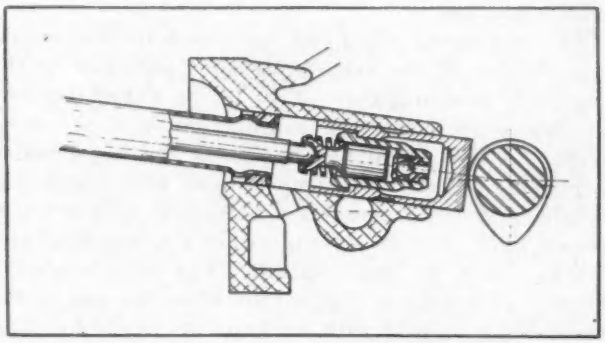


Fig. 13—Production application of hydraulic unit in a light air-cooled aircraft engine.

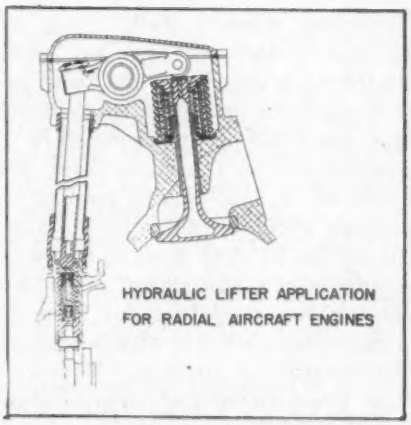


Fig. 14 — Hydraulic lifter application for radial aircraft engine.

Cam Design

Ample bearings and body section should be provided in the camshaft consistent with the weight of the reciprocating parts. Then the object is to provide a cam design which will open the valve as rapidly as possible. We find it an advantage to compare accelerations of one engine to another on the basis of acceleration load. Usually the load at maximum speed can go as high as 350 lb on an average size passenger car L head engine and as high as 230 lb on an overhead job. This means the acceleration may go as high as 18,000 ft per sec per sec at the maximum over-speed for the L head engine and as much as 8000 ft per sec per sec for the overhead valve engine. There are many controversial ideas about how the acceleration should be applied; this difference of opinion is probably due to the relationship of the rate of acceleration and the duration of acceleration to the natural frequency of the valve gear, and probably explains one of the reasons for the necessity of motion study of the valve train as a whole.

The nose of the cam should be large enough to prevent over-stressing between the cam and follower; as

(*Turn to page* 92, *please*)

Industry *Awaits Signal to Begin* Changeover

By Leonard Westrate

SINCE Pearl Harbor the automobile industry has been working full blast on war production, giving it the undivided attention and full measure of effort required to turn out its large share of the prodigious volume of weapons needed to liquidate the enemy. In recent weeks, however, it has been working with an eye on the clock, because it knows that the time of war is running out. It knows, too, that peace in Europe will bring with it the complex and perplexing job of changing a substantial part of this most scrambled of all industries back to peacetime production of automobiles in as short a time as possible.

The evident concern about making the changeover as quickly and with as little disruption of the domestic economy as possible is apparent everywhere. Stage hands of both government and industry already are backstage, standing by to move in and shift the properties as soon as the curtain falls on the war in Europe. A flood of V-E (Victory in Europe) Day plans have come out of Washington in recent weeks dealing with plant clearance, removal of manpower and materials controls, and other important problems that will vex the industry in reconversion.

On their part, the automobile makers are doing all the spadework they can under present limitations and the press of war work. They are shuffling production around to clear as much floor space as possible by buying or leasing additional facilities or rearranging present plant layouts. They have been in touch with suppliers of components and have made preliminary moves to get needed machine tools. There is, however, a general feeling throughout the industry that the time is very late, and that while the plans of the government are excellent as far as they go, more definite action is needed, and soon, to translate the good intentions into concrete performance. This would include such tasks as deciding which plants will be kept in production until the war with Japan is finished and which government-owned machines will be available for purchase.

Recently they have been granted permission by WMC to use planning engineers and technicians for preliminary work on preparation for resumption of civilian passenger car manufacture as long as their use does not interfere with high urgency war work. This permission authorizes them to use men for such work up to 1 per cent of their total employment under manpower ceilings without additional authorization. Those companies requiring more than the 1 per cent limitation may make application under WMC and WPB procedures relating to use of workers for civilian production. WMC has stated that if necessary, the 1 per cent limitation might be increased, but at the same time reserves the right to withdraw approval of the program, wholly or in part, if military developments should make such action necessary.

Authorization of use of manpower was approved for the following types of preparatory work: 1. To bring materials specifications up to date. 2. To correct any weakness in the 1942 models. 3. To make changes necessary to distinguish new models from the 1942 model. 4. To prepare plant layouts. 5. To undertake any related preparatory work, such as determining which government-owned machines, if any, can be purchased or used, and planning for reconditioning machines. This last category is designed to make the plan flexible enough to take care of necessary preparatory work not covered in the other four.

George Romney, managing director of the Automotive Council for War Production, has stated that the industry is substantially in agreement with the guiding principles of the plan; namely, that no civilian production should be undertaken which would interfere with war work of high urgency and that the assignment of workers to such planning should be limited to planning engineers and technicians and shall not constitute a drain upon production workers needed for continued urgent war output. It also should be noted that the program does not permit the transfer of workers from war production, does not change present rules and regulations on use of manpower for civilian production, and does not change procedures for obtaining materials for experimental work or civilian production.

WMC officials have stated that although the program applies exclusively to automobile manufacturers at this time, they expect to grant similar authorization to parts companies and tool and die companies in the near future, but are uncertain when that may be. Permission has been granted Detroit engineering service companies to assign personnel to planinng resumption of civilian automobile production if such action does not interfere with war work.

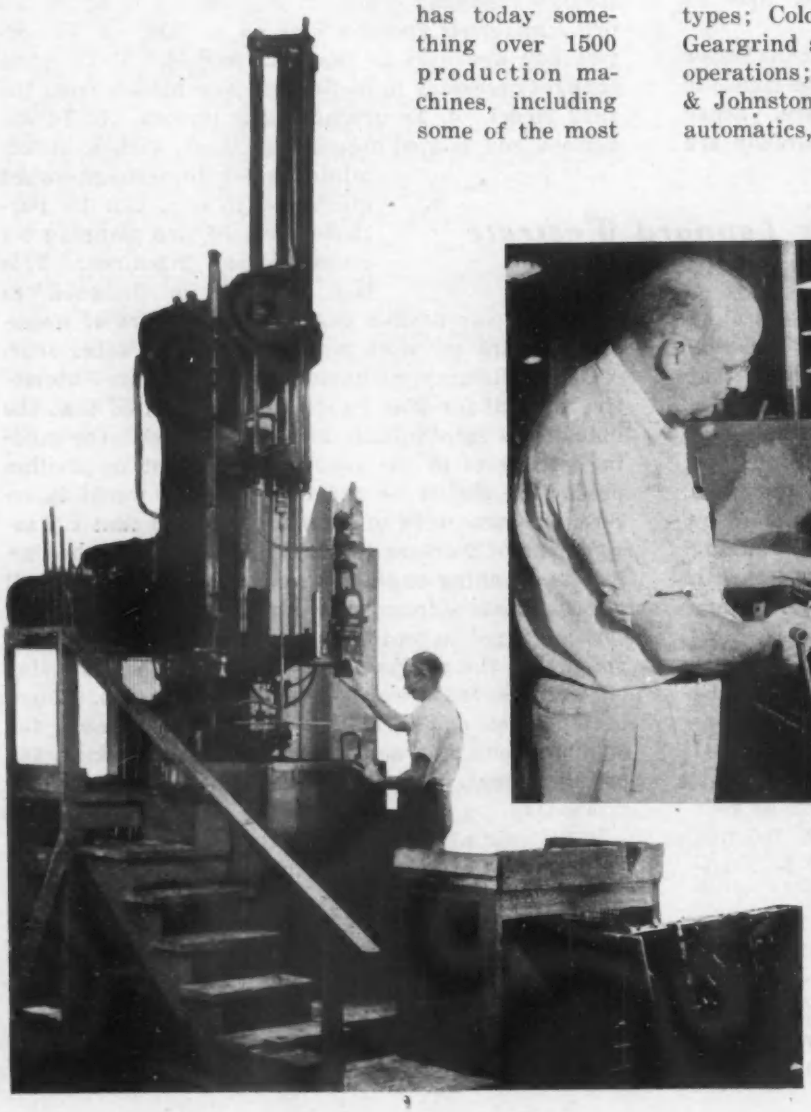
This is the Ninety-eighth in the series of monthly production features

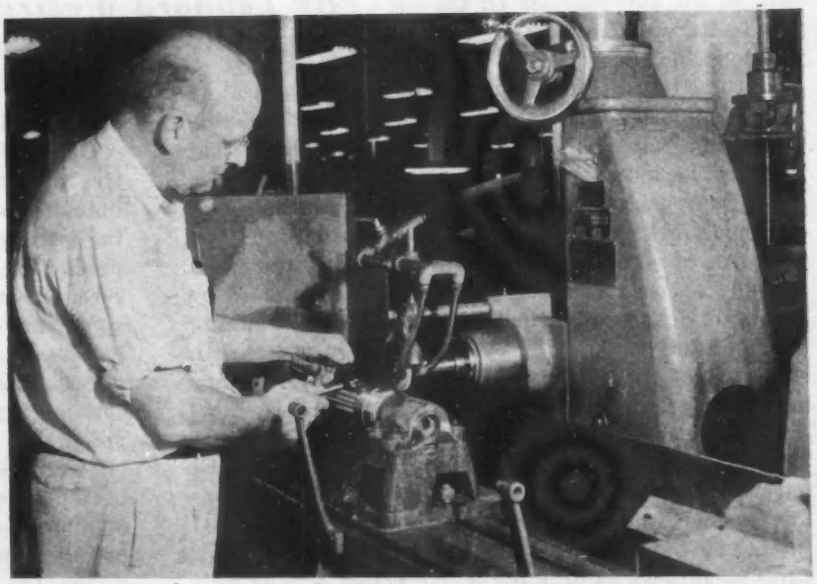
Cadillac Concentrates

Over 1500

EARLY this year the Cadillac Division, General Motors Corp., celebrated its Fifth Anniversary as a producer of precision parts for the famed Allison liquid-cooled airplane engines. Starting in 1939 with the manufacture of about five parts, in a relatively small space, Cadillac has extended the scope of aircraft parts production to a large group of major parts and complete assemblies. Among the most accurately finished parts are the supercharger rotor vanes, which are balanced to 0.004 ounce; and bearing cages, where the total variation in hole size, after pressing into the case is held to 0.0005 in.

The Cadillac Aircraft Division has today something over 1500 production machines, including some of the most modern equipment known to the art. Although it is quite beyond the scope of this article to provide a complete picture, a few examples of well-known machines may be cited: Cincinnati equipment includes—Hydrotels of several types, Centerless grinders, Duplex milling machines, Hydromatic mills, plain and hydraulic grinders; among the Norton equipment are—cylindrical grinders, camshaft and crankshaft grinders, Cam-O-Matics, Norton Lap, Hypro-Lap lapping machines; Heald is represented by internal grinders, precision boring machines; Ex-Cell-O precision boring machines and thread grinders are found in several types; Colonial broaches, Keller profiling machines, Geargrind spline grinders are represented on various operations; among the turning equipment are—Potter & Johnston turret lathes, W & S turret lathes, Fay automatics, Lo-Swing lathes; many honing operations





(Above)—One of a large battery in the grinding department, this Geargrind precision grinder is used for the finish-grinding of splines.

(Left)—In a special corner with plenty of overhead clearance is this towering Barnesdril vertical honing machine for honing the bore through the camshaft.

General view in propeller shaft department showing arrangement of machinery in parallel rows, with finished parts in the center for convenience in process inspection.

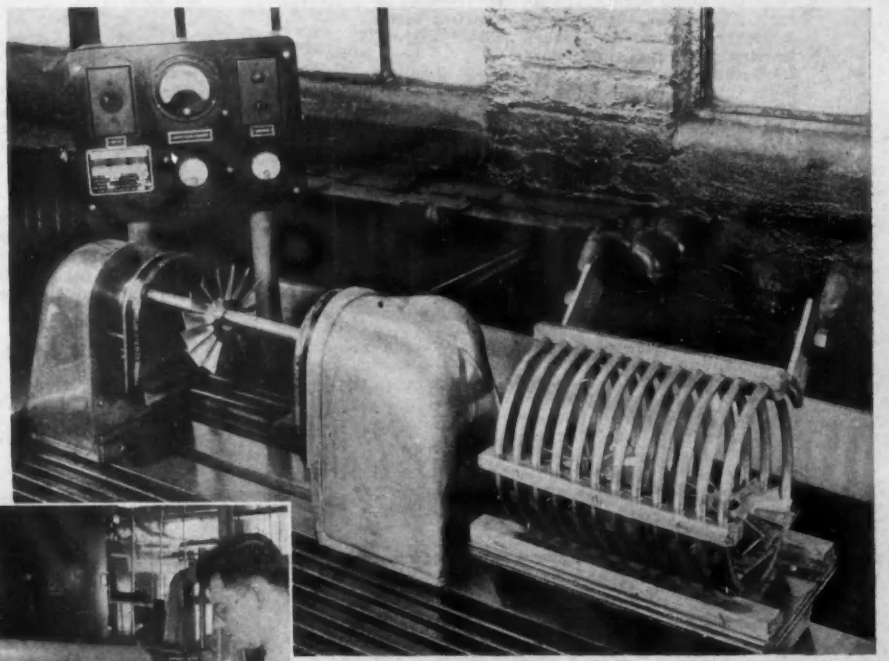
By Joseph Geschelin

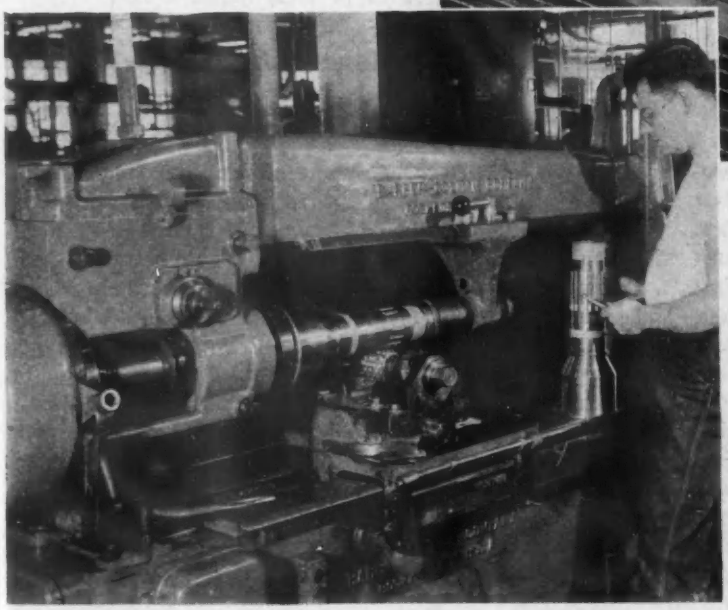
Production Machines

on Allison Engine Parts

are handled with Barnesdril honing machines fitted with Micromatic honing tools.

In previous articles in this series we have had occasion to stress the features which distinguish aircraft parts production. Chief among these are the basic problems of heavy metal removal, oft-times of the order of 75 per cent or more, and the painstaking attention to quality both in dimensional tolerances and in surface finish. Touch-





(Above)—One of a battery of Magnaflux machines in the supercharger vane department for inspecting surface perfection of machined forgings.

(Left)—Heavy-duty Type A, long bed Barber-Colman hobbing machine is shown here hobbing splines on a propeller shaft.

Factory Routing Shaft

OPERATION	EQUIPMENT
Cycle normalize	Furnace
Anneal	
Shot blast	
Inspect	
Drill 2⅝ dia. hole through	Barnes Hydram drill
Chuck on small end, straddle face flange to 7/16 wide, turn flange to 8¼ dia., bore 3⅜ and 5⅝ hole to start core drills, drill 3⅛ hole, drill 5⅝ hole, rough machine 35 deg. angle	6D Potter & Johnston turret lathe Libby turret lathe
Chuck on flange end, face length to 17 17/32 O.A., drill 3 1/16 dia. to 2 15/16 dia., drill 2 9/16 dia. through, turn relief dia. to 3 7/16, turn thread dia. & bearing dia., chamfer hole in small end	6D Potter & Johnston turret lathe Libby turret lathe
Rough turn spline thread & bearing dias, on small end to 4 3/16, rough turn small end, rough turn small flange OD to 4 19/32 & rough turn 30 deg. angular surface, rough turn 6 in. dia.	Sundstrand Model "A" stub lathe
Inspect	
Stress temper at 1200 F for 2 hours, cool	
Inspect	
Chuck on small end, straddle face flange, bore 5⅝ dia., bore 3¼ dia.	6D Potter & Johnston turret lathe
Chuck on large flange, finish turn 5 5/16 dia., finish turn 3.432 thread dia., finish turn bearing, dia. face end, bore 3 1/6 dia., bore 2 57/64 dia., bore thread dia., bore 2.805 dia., bore 2 57/64 dia., bore 2 11/16 dia.	6D Potter & Johnston turret lathe Libby turret lathe
Finish contour turn outside from small flange to large flange	Reed Prentice lathe Model "AA"
Finish turn spline dia. thread dia. and bearing dia.	Sundstrand Model 10 Type "A" stub lathe
Inspect	
Harden	
Wash	
Temper	
Shotblast	
Inspect	
Grind centered case of flange, grind spline dia. to 3.827-3.828, grind flange dia. to 8.078-8.079. Grind 6.015-6.016. All dia. to be concentric & parallel within 0.0003 total indicator reading	16x48 Norton grinder
Finish face spline end & countersink 30 deg. to 3⅛ dia. center	14 in. Monarch lathe
Countersink flange end 60 deg. to 6 in. dia.	14 in. Monarch lathe
Regrind steady rest bearings true after recentering all dias. to be concentric & parallel within 0.0003 total indicator reading	16x48 Norton grinder
Drill 16—11/32 in. dia. holes in flange & burr	H-2 Barnes Hydram drill
Grind bearing dia. to 3.9434-3.9445 & bump shoulder of 4¾ in. dia. flange to 6.221-6.224 dia.	16x48 Norton grinder
Grind largest external thread dia. to 3.9335-3.9345	10x36 Norton grinder
Grind dia. behind splines to 3.818-3.819	16x48 Norton grinder
Grind bearing dia. behind first thread to 3.5070-3.5080 dia. with ⅛ rad. in corner	16x48 Norton grinder
Grind first external thread dia., to 3.4295-3.4305	16x48 Norton grinder
Grind dia. at small end to 3.3055-3.3065	16x48 Norton grinder
Grind 3 27/32 dia. thread relief and 3 5/16 dia. thread relief	10x36 Norton grinder
Grind 1/16 x 45 deg. chamfer	10x36 Norton grinder
Polish, both thread reliefs & break corners	Reed-Prentice lathe
Polish ID & ¼ recess	Cisco lathe
Wash & oil	
Inspect	
Tin plate OD & ID of shaft	
Inspect	
Chuck small end. Grind 5⅝ inside dia. to size & form 35 deg. slope including ⅜ in. radius	#74 Heald internal grinder
Chuck small end & grind out 3¼ dia. bullet shaped hole to 3.120-3.121 & Join 1 9/16 radius at bottom. Grind 3.122-3.123 dia.	#72-A5 Heald plain internal grinder
Grind 2 11/16 dia. hole to size	16x16 Bryant internal grinder
Finish grind 6 in. dia. & bump front face of flange	16x48 Norton grinder
Etch numbers & heat letters on front face of flange	
Finish grind 30 deg. angle & ¼ radius	10x36 Norton grinder
Grind ¾ radius	10x36 Norton grinder
Grind OD of 4⅝ dia. flange to size	16x48 Norton grinder
Semi-finish grind 3.939-3.940 and bump shoulder to 6.219-6.222 dia.	10x36 Norton grinder
Semi-finish grind center bearing to 3.815-3.816 dia. & 16 radius at end	10x36 Norton grinder
Semi-finish grind spline dia. to 3.807-3.808	10x36 Norton grinder

ing on the matter of metal removal, crankshaft forgings weigh 350 pounds rough and are reduced to but 129 pounds when finished. Camshaft forgings weights are 26 pounds rough, 7.5 pounds finished. The propeller drive shaft, hewn from a solid forging weighing 90 pounds, weighs but 18 pounds finished. The forked connecting rod weighs 17.5 pounds in the rough and is finished to 4.56 pounds.

Since the inception of this project, Cadillac has developed many ingenious methods for improving quality and reducing man-hours required to produce individual parts. To this end has been applied a know-how acquired from the background of quality motor car manufacturing stemming from the beginning of the industry. As a result, Cadillac is producing in large quantity a variety of supercharger rotor vanes, machined from solid steel forgings by progressive metal removal stages. Most of the metal removal—starting with a forging weighing 13.31 pounds and finishing with a vane weighing 2.49 pounds—is done on ingenious milling machines of various types developed for the purpose by DeVleig. Following the various stages of metal removal, polishing, etc., the vanes are balanced on GMR-designed dynamic balancing machines to 0.004 ounce, then analyzed for material perfection on a Magnaflux machine.

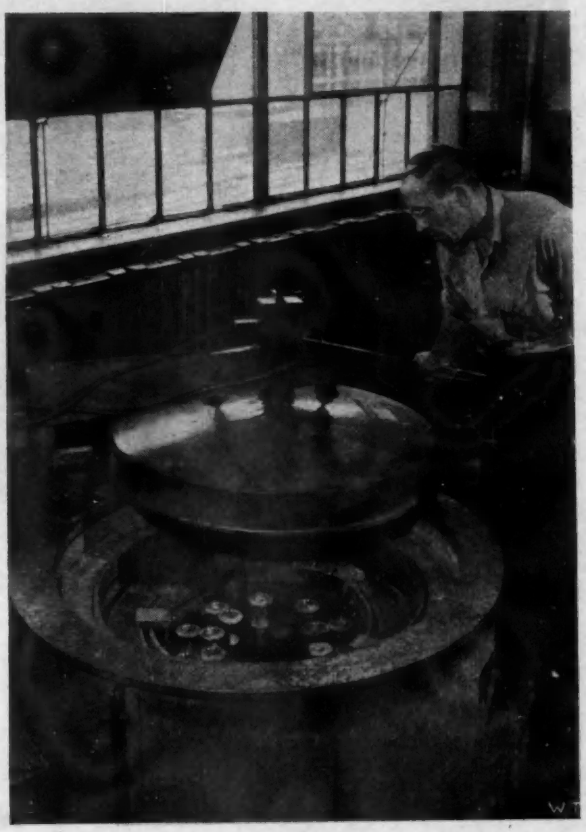
Owing to the large variety of parts produced by Cadillac and the great multiplicity of individual operations required for each part, it is obviously beyond the range of a survey article to cover the activity ex-

—Propeller Drive

OPERATION	EQUIPMENT
Semi-finish grind bearing dia. to 3.503-3.504	10x36 Norton grinder
Grind 1/16—45 deg. chamfer on spline end	10x36 Norton grinder
Hob splines	Barber-Colman Type "A" long bed hobbing machine
Chamfer splines	#50 Cross Gear chamfer machine
Drill & ream 0.250 dia. hole between splines. Rough & finish counterdrill 0.375 counterbore between splines	Footburt drill press
Burr 0.250 dia. hole in I.D. of shaft	
Wheel polish radius end of splines & file edges of splines & blend splines	Bench
Wash & oil	
Inspect	
Tin plate 8.062 dia. flange and 6 in. dia. to ¼ only from flange	
Inspect	
Degrease	
Nitride shaft to spec. E. S. 269	Nitriding furnace
Inspect	
Bump face of flange to clean up	Landis external grinder
Grind 3.125 internal dia.	#72-A-5 Heald plain internal grinder
Clamp on flange end. Grind 3 1/16 in. dia. bore with ⅛ in. radius at bottom to size. Grind 2.810-2.815 dia. to size. Grind 2.805-2.806 dia. to size	16x16 Bryant internal grinder
Clamp large flange. Grind 2 57/64 in. dia. recess ¼ in. wide with 1/16 in. radius at bottom to size. Grind 2 57/64 in. relief to size	#72A-5 Heald internal grinder
Drill 8—17/64 in. holes in small end	Footburt drill press
Mill 2 slots in small end	Cincinnati 24" box Col. drill press
Burr holes & polish lock slots	Bench
Polish 3.125 dia. & 2 11/16 dia., remove tin from 3 5/16 in. dia. & 3 5/16 recess	Cisco lathe
Wash & oil	
Inspect	
Cadmium plate. Mask bearing dias. & splines	
Inspect	
Recenter small ends	16 in. Monarch lathe
Grind internal thread in small end	#35 Ex-Cell-O thread grinder
Grind 3 7/16-12 pitch thread	#35 Ex-Cell-O external thread grinder
Grind 3 15/16-16 pitch thread	#35 Ex-Cell-O thread grinder
Remove incomplete 12 pitch thread	#1M Kent-Owens hand mill
Remove incomplete 16 pitch thread	#1M Kent-Owens hand mill
Finish grind 3.810-3.812 dia. to size & 1/16 radius	10x36 Norton grinder
Finish grind spline dia. to 3.802-3.804	16x48 Norton grinder
Finish grind 3.500 bearing to 3.498-3.500	16x48 Norton grinder
Semi-finish grind 8.062 dia. to 8.064	16x48 Norton grinder
Finish grind splines	Gear Grinding Machine spline grinder
Wheel polish radius end of splines, blend splines, wheel break ends of splines & emery polish edge of splines	Bench
Mask & polish incomplete threads & burr & ream 0.250 hole	
Compound polish splines & threads	
Wash in kerosene	
Finish grind OD of large flange to 8.062	16x48 Norton grinder
Finish grind 0.080-0.092 x 45 deg. chamfer on outside end of large flange	10x36 Norton grinder
Ream 16 — 0.3745-0.3755 dia. holes in large flange	#221½ Barnesdril
Countersink 16 holes at 90 deg. to 27/64 dia.	24" Cincinnati drill press
Finish grind 3.9368 dia. bearings to size, grind face of 4⅜ dia. flange & grind 0.060-0.080 radius at bottom of flange	16x48 Norton grinder
Finish grind outside face of 8.062 dia. to 6.216 length	10x36 Landis grinder
Burr 16 holes, belt & hand polish 6 in. 60 deg. center	Bench
Break 4 corners, polish threads & polish face of flange	Reed-Prentice lathe
Wash, dip in oil	
Final inspection, Magnaflux & etch	

cept by touching upon specific high-spots. However, some impression of the magnitude of the task involved in aircraft parts production may be gained from an examination of the factory routings on the propeller drive shaft and the camshaft which are reproduced in their entirety.

Naturally in an operation resulting in an unusual volume of chips, painstaking attention has been given to the adoption of special tool materials in the interest



Among the many items of equipment required for the heat treatment of camshafts is this pit-type Leeds & Northrup Homo furnace.

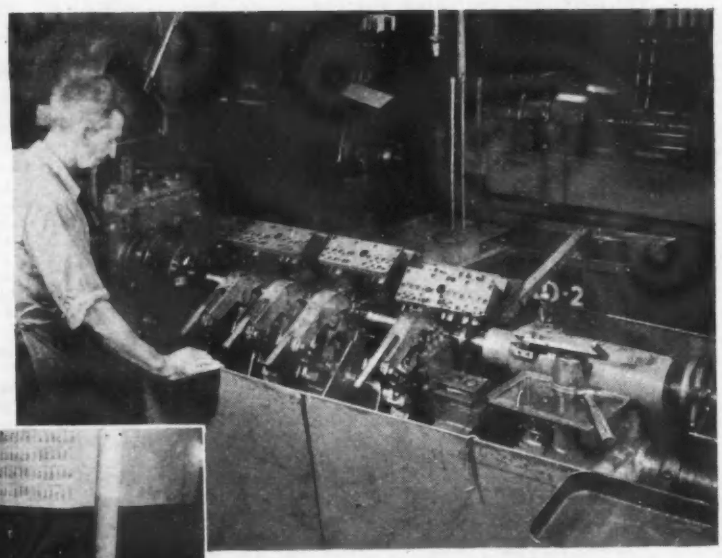
of improving surface quality and reducing production time. One striking example of this is found in the adoption of Carboloy steel-cutting-grade tools on the connecting rod line. The use of Carboloy-tipped milling cutters has increased productivity about 3 to 1, while cutting speed has been stepped up about 5 to 1 as compared with H-S-S tools. In addition, cemented-carbide-tipped fly-cutters are employed on the various Heald and Ex-Cell-O boring machines.

Another example of modernity is the wide use of shotblasting on connecting rods. Shotblasting is employed not only to improve the fatigue resisting properties of the parts but also as a means of reducing many hand burring operations. With the background of experience gained with shotblasting as a means of improving fatigue resisting properties of highly stressed parts, Cadillac engineers turned to a unique method of producing the same results on small bores and highly finished surfaces. This has resulted in the development of "Vapor-Blasting" in which such pieces are subjected to a stream of oil, under pressure, the liquid being charged with abrasive particles. This technique is being studied for applications to a variety of parts.

Honing is extensively employed for the finishing of fine bores. Vertical Barnesdril honing machines are used for the honing of the bore extending the length of camshafts; and for the finishing of bores in crankshafts. Micromatic honing machines are used for finishing connecting rod bolt holes to assure precise fitting and to improve the fatigue properties of the parts.

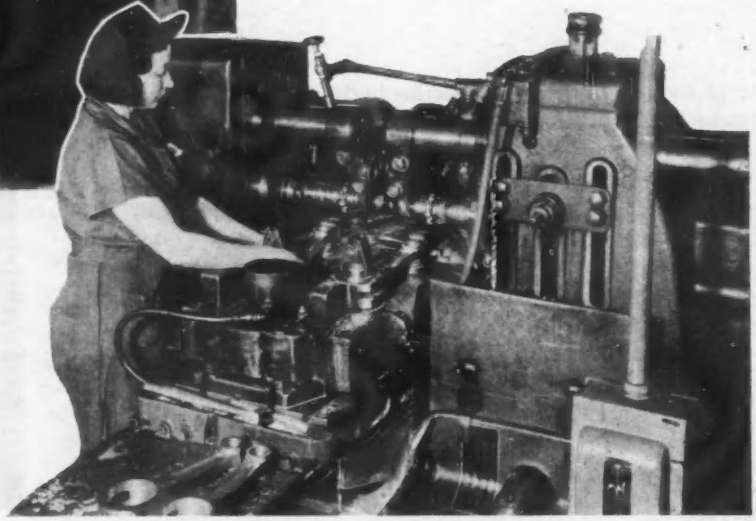
Precision boring is another specialized technique employed wherever it can be applied advantageously. One application is the use of a Heald Bore-Matic on the gear reduction case, combining in one setting—boring, facing, and chamfering—an operation which previously required four operations on two machines.

Selective fitting of piston pins has been eliminated by the adoption of a modernized technique of lapping. The pins now are ground in Cincinnati Centerless grinders, lapped in Cincinnati Centerless lappers, then rough- and finish-lapped in the familiar Norton Hypro-



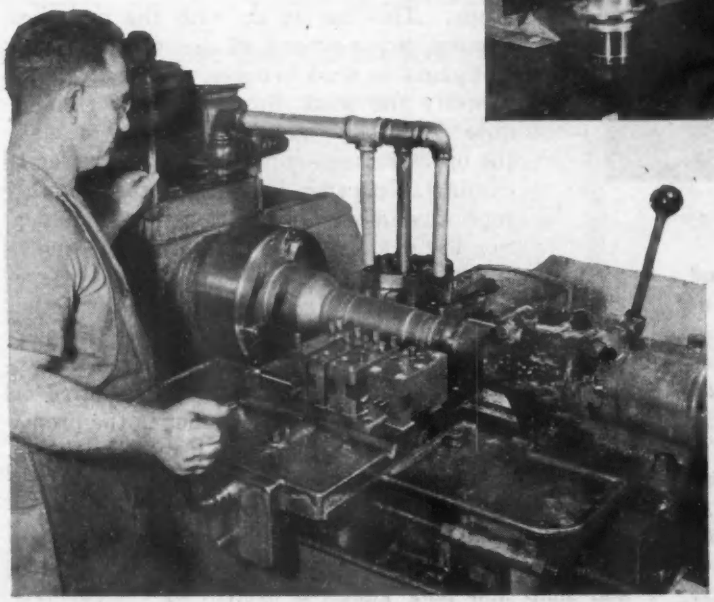
(Above)—View of J & L 12 in. Fay automatic lathe in the camshaft department used for facing sides of cams and bearings. Note the detail of individual tool blocks with their multiplicity of tools.

(Above)—This Microhoner, of two-spindle type, handles the finish honing of con rod bolt holes in rods and caps.



(Right) Milwaukee Duplex mill, rise-and-fall type, is tooled for profiling connecting rods.

Typical of the painstaking analysis of inspection operations is this bench for final inspection of propeller shafts. The gamut of snap gages, depth and height gages, plug and thread gages, ring gages, etc., have been arranged in the sequence in which they are to be used. This procedure routinizes the work of inspectors, prevents error of omission.



Sundstrand heavy duty Model A Automatic lathe tooled for turning spline end, thread, and bearings on propeller shafts.

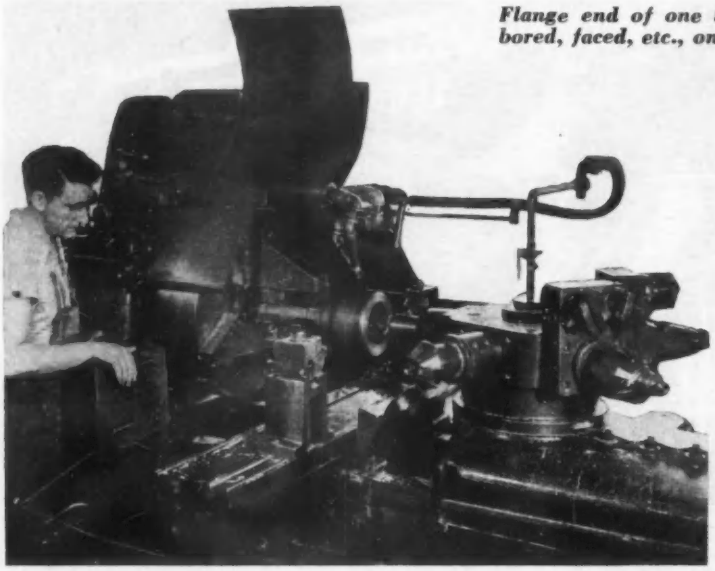
This four-spindle Cincinnati Hydro-Tel, one of many at Cadillac, is used for the profiling of Allison connecting rods.

Lap. This procedure has increased production, enhanced the quality of surface finish, and has reduced taper and deviations from standard tolerances.

Several types of bearing cages are produced to exceedingly fine limits. Following the preliminary turret lathe operations, the OD is ground to a 0.001 in. tolerance to fit the diaphragm chuck used in grinding the ID. For this operation, they use an expansion chuck which serves to hold the roundness of the work. The ID is ground to an established size taking into account corrections for deflection due to the chuck, and for compression when assembled into the gear case. In addition, allowance is made for the Granodized coating which is applied later. The size of the bore is stamped on the cage for the purpose of matching the arbor size for the finish grind of OD. The OD dimension is established by selecting a wall thickness dimension taking into account the theoretical size of the OD after it has been compressed into the case.

For the assembly of gear reduction cases Cadillac has an air-conditioned department to provide dimensional control, under standard temperature conditions, and to assure cleanliness of the operation. Assemblies are flushed and cleaned by running in a special mixture for five minutes. During this interval, a 10W oil, held at a temperature of 165 F to 175 F is circulated at 18 pounds pressure. This oil is constantly filtered to remove dirt and chips.

The nitrided Allison crankshaft is an outstanding example of coordinated process and control at various stages due to the multiplicity of individual operations required from start to finish. Actually the machining operations are divided into a number of stages The first stage is that of primary and semi-finish turning and primary milling operations. Following this the work is stress re-



Flange end of one type of propeller shaft being turned, bored, faced, etc., on a Potter & Johnston Model 6D turret lathe.

relieved by heat treatment, checked for run-out, and recentered. This is followed by another series of turning, grinding, boring, drilling, etc., then stress-relieved for a second time, and recentered if necessary. A series of preliminary finish-grinding operations follow next, including various steps of surface finishing and lapping.

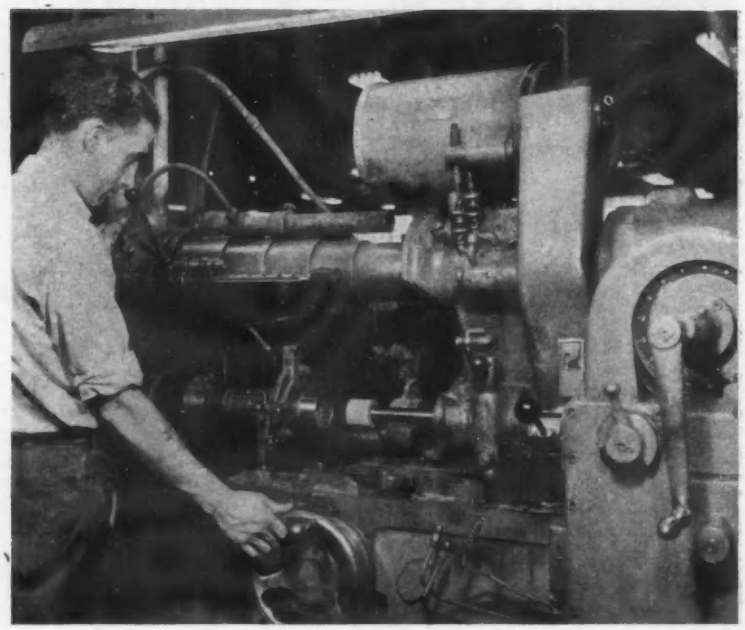
The final stage is preceded at this point by washing, oiling, and degreasing in preparation for nitriding, then nitriding. The shafts now are checked for run-out and proceed to final grinding operations, balancing, surface finishing, Magnaflux inspection, etc. Then the work is washed, cooled, and wiped clean for the finishing touches and inspection. Before acceptance, the shafts are again Magnaflux-inspected, all minute scratches are removed, main and crankpin bearings are polished in a Norton Crank-O-Lap. It is of interest to note that all bearing dimensions are checked with the P & W Electro-limit gage.

In keeping with the exceedingly fine tolerances both on dimensions and on surface finish, quality control has been developed with painstaking attention to minute details. For example, the Sheffield Shadowgraph gage is employed in checking various parts, including the wall thickness of bearing cages. P & W Electro-limit gages are used for checking diameters such as on the crankshaft. Surface quality of piston pins is examined under 400-watt high intensity mercury vapor lamps which have no reflections from the highly finished work. All gages and instruments are periodically checked, repaired, or rebuilt in a gage laboratory housed in an air-conditioned room.

But there is another side to the inspection procedure. Besides assuring the maintenance of fine tolerances under controlled conditions, Cadillac has developed specialized inspection procedures based upon micro-motion study. This has to do with the most economical arrangement of inspection devices and gages on work benches, so designed as to simplify the work for the operator, minimize "reaching" and, in general, to make the operation so simple and so routine as to eliminate operator fatigue on these highly repetitive tasks. In addition this simplification has made it possible to utilize women in jobs that heretofore necessitated long periods of specialized training. An illustration shows the inspection of a propeller drive shaft on a long bench which permits two operators to work in comfort. Note the arrangement of gages of every description mounted on the board, not only within easy reach but in the proper sequence of the successive steps of inspection.

An example of the company's development of better inspection methods is the manner in which the engine crankshaft is inspected. Instead of using the conventional method involving micrometers, Jo-blocks and snap and plug gages, a system of comparative checks has been developed utilizing master discs and rings and master step gages. A triple-step block is placed under the various crank throws to position them before inspection. The crankshaft is centered in fixed rollers and the entire set-up is mounted on a

(*Turn to page* 54, *please*)



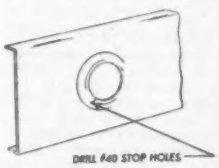
One of the many applications of the versatile Bryant internal grinder is this view of a 16 x 16 Bryant finish-grinding the bore of a propeller shaft.

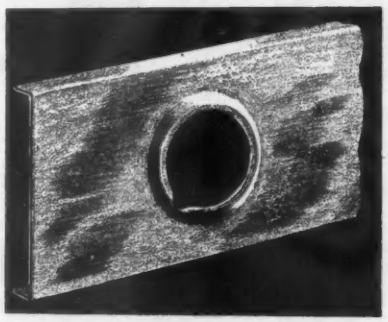
Recommended Methods for the **Salvage** *Repair at the Factory of*

Damaged Parts on Airframes

These operations have been prepared from drawings and data compiled by the Engineering Committee of the Aircraft War Production Council, Inc. Unless specified otherwise material must be same type and thickness as damaged part; rivet type, size and edge distance must conform to AN standards.

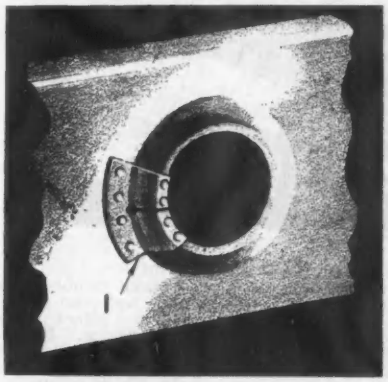
Cracked Flange Beaded Lightening Holes

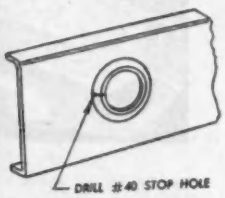




For single crack less than two-thirds width of flange. Not for highly stressed parts.

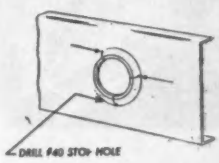
Drill No. 40 (.098) stop hole at end of crack. Remove area outward from drilled hole, minimum radii 0.125 in.; remove burrs.

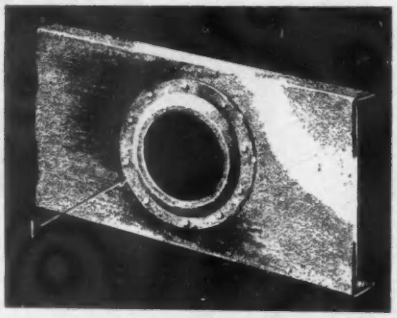




For cracks that extend more than two-thirds but not more than four-thirds the width of flange.

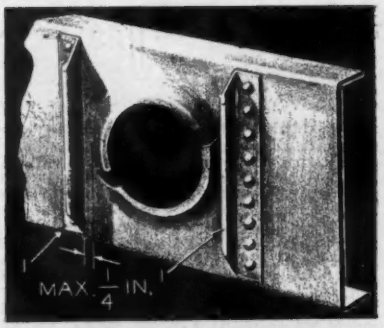
Drill No. 40 (.098) stop holes. Attach formed doubler (1) with minimum of six rivets; two in flange, one each side of crack; and four in sheet, two each side of crack. Space rivets approx. 6.0 times their diam. Doubler may be expanded for additional cracks as required.





For two or more cracks extending two-thirds but not more than four-thirds the width of flange.

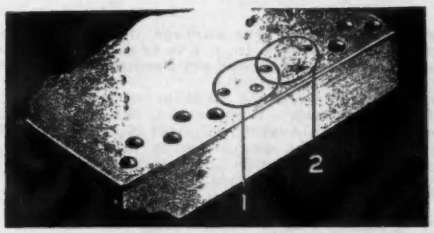
Remove cracked area of flange as in first example, or remove entire flange (optional). Attach fully formed doubler (1). Doubler may be cut from rejected rib with similar lightening hole if good section is obtainable. Space rivets approx. one-quarter times lightening hole diameter but not greater than 8.0 times rivet diameter.



For two or more cracks extending two-thirds but not more than four-thirds the width of flange; limited for cracks not less than 40 deg. from vertical.

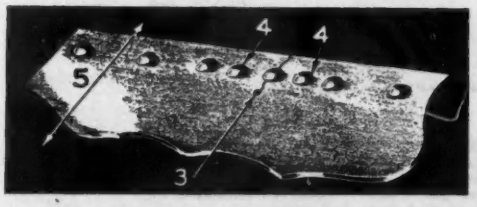
Remove cracked areas as in first example. Locate and rivet stiffener (1) to vertical web, as close to edge of flange or cleaned-up area as possible; 0.25 in. max. distance; extruded bulb angle preferred otherwise formed angle may be used. Stiffeners may be placed either side of web with end rivets through cap member legs where possible. Space rivets about one-quarter times lightening hole diameter, but not greater than 8.0 times rivet diameter. Stiffener length to be full web height; width of outstanding leg not less than 10t nor greater than 15t; scarfed ends optional.

Damaged Rivet Holes



For slightly damaged holes in sheet, where damage is completely removed by use of appropriate drill for next larger size rivet; does not apply to dimpled sheet. (1—Elongated hole. 2—Cracked hole.)

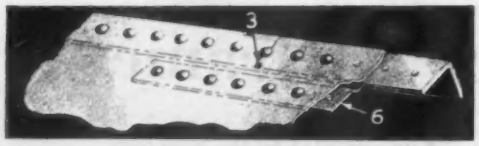
Remove damaged area with appropriate larger drill and install next larger size rivet.

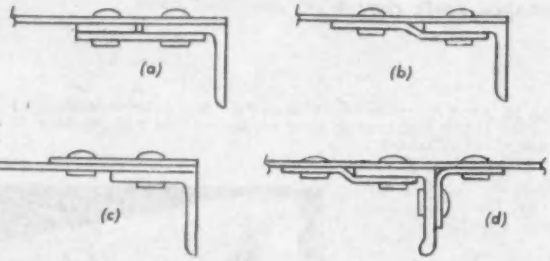


For cracked holes in sheet where next drill size is not sufficient to remove crack; length of crack limited to 8t; limited to not more than one crack in five consecutive rivet holes or more than 10 per cent of total pattern. Use applies only when direction of principal load (5) is normal to rivet row.

Drill No. 40 (.098) stop hole (3) if crack does not terminate

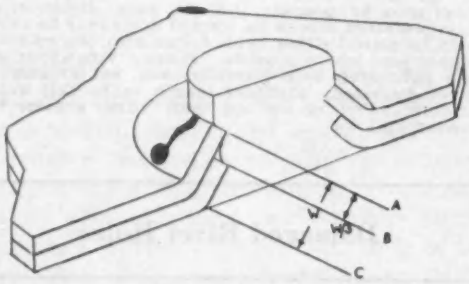
in rivet hole. Add one extra rivet (4) on each side of damaged hole; minimum spacing permitted is three rivet shank diameters.





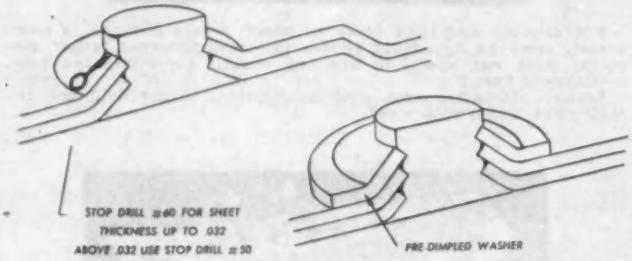
For cracked holes in sheet where next drill size is not sufficient to remove crack; length of crack limited to 10t. Limited to not more than two cracked holes in five consecutive holes or more than 20 per cent of total pattern.

Drill No. 40 (.098) stop hole (3) if crack does not terminate in rivet hole. Provide a formed doubler (6), same material and one gage heavier than damaged sheet; length sufficient for installation of three rivets at each end past damaged hole (s); width sufficient to provide additional parallel attachment to skin. Install doubler on underside as shown; use identical rivets and spacing as in sheet attachment with minimum of three rivets each side of crack. Original skin-attachment rivets are replaced through doubler, using longer rivets. Alternate repairs are shown at a, b, c, d. This method may be used for dimpled holes where dimple crack extends into flat sheet.



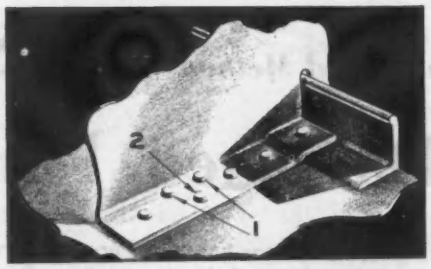
For cracked dimples where damage does not extend into flat sheet; limited to not more than one crack per dimple and only one in ten consecutive dimples; not permitted for more than five per cent of total rivet pattern.

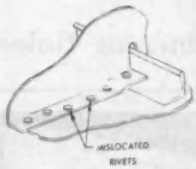
When crack exends from A to B or less than one-third dimple width (W/3) leave as is. When crack extends from A to C but not greater than dimple width W, drill No. 60 (.040) stop hole at end of crack for sheet gages up to and including 0.032; for greater gage sheet use No. 50 (.070) drill.

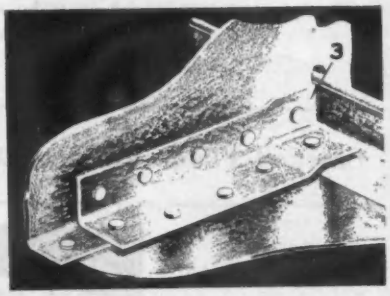


For cracked dimples where damage does not extend into flat sheet; limited to not more than three cracks per dimple and on not more than five consecutive dimples; not permitted for more than ten per cent of total rivet pattern.

Drill stop holes, No. 60 (.040) for all sheet gages up to and including 0.032, No. 50 (.070) for greater sheet thickness; remove rivet. Make one pre-dimpled washer from 0.032 Stainless Steel, minimum diam. ⅝ in., larger as required; may also be made from AN9 60-D standard aluminum alloy washer. Install pre-dimpled washer with longer rivet.





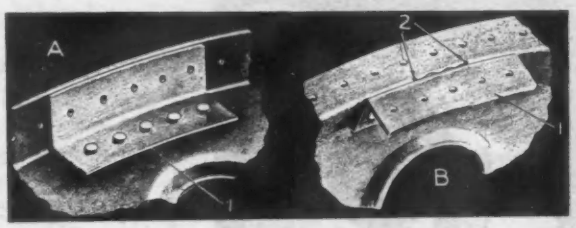


For reduced edge distance caused by rivet mislocation.

Repair A—Limited to not more than five consecutive displacements or more than 50 per cent of total rivet pattern. Do not use for skin splices without Engineering Approval. Install two rivets (1), next smaller size than original pattern, one on either side of mislocated rivet (2). Do not remove mislocated rivet.

Repair B—Limited to not more than ten consecutive displacements or more than 50 per cent of total rivet pattern. Make doubler (3) sufficiently long for one rivet at each end past mislocated rivets; width sufficient to provide adequate edge distance to mislocated rivets: install as shown.

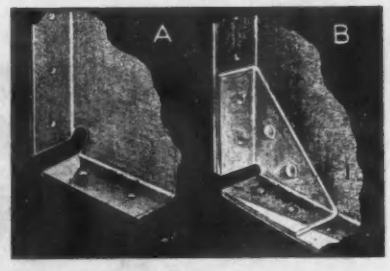
Damaged Formed Flanges



For crack in bend limited to max length of 50t.

Repair A—Drill No. 40 (.098) stop holes. Make doubler (1) long enough for minimum of four rivets in each leg; end rivets to be outside damaged area. Attach doubler to web sheet using same type rivets and spacing as designed for flange. Rivets through flange and outside doubler leg are to be installed on assembly to adjacent structure.

Repair B—Alternate to repair A; use only when clearance reasons require. Locate outstanding doubler (1) leg flush with formed flange. (2) Drill No. 40 (.098) stop holes at both ends.

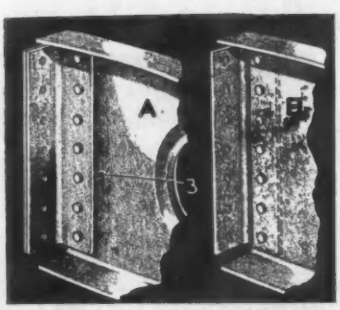


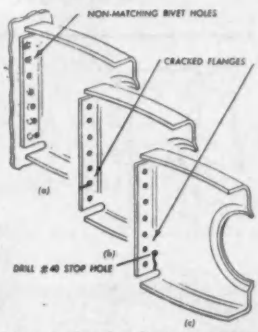
For crack in corner of double-formed flange.

Repair A—For length of crack limited to 8t. Drill No. 40 (.098) stop hole. Remove area outward from drilled hole, min. radii 0.125 in.; remove burrs.

Repair B—For length of crack limited to 25t. Drill No. 40 (.098) stop hole. Make doubler (1) large enough to allow at least two rivets in each attaching face. Nest doubler to inside flanges and attach to web sheet with rivets beyond end of crack. Minimum spacing between any two rivets to be six times diam. of rivet. If flange or web sheet attaches to other structure, delay riveting

until later assembly. Doubler may also be installed back-to-back with damaged member similar to method of preceding example B.



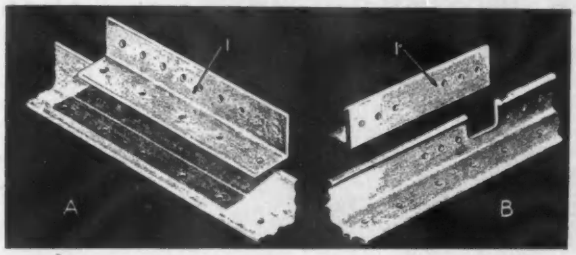


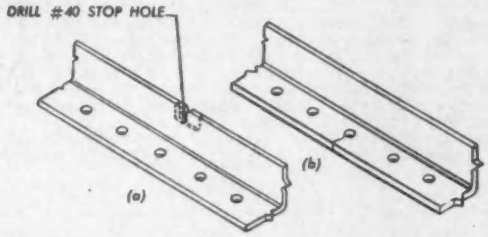
For cracks, oversized or non-matching holes in flange; extent of damage limited to flange only.

Repair A—Drill No. 40 (.098) stop holes where necessary. Damaged flange may be removed (optional). Make doubler (3) full length or long enough for damaged area only. Rivet doubler to web sheet. Install rivets through outstanding flange or doubler leg when assembling to adjacent structure. For long flanges length of doubler may be reduced to apply to damaged area only; use a minimum of four rivets in each doubler leg, at least two on each side of damaged area.

Repair B—Alternate to repair A; use only when clearance reasons require.

Damaged Stringers

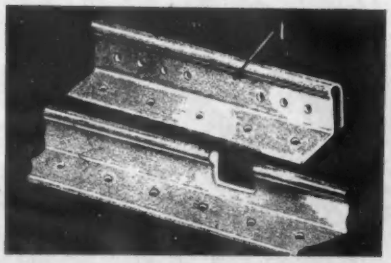




Note: When damaged area exceeds four in. in length investigation for possibility of replacement is advisable.

For plain or bulb angle section. Method applies to A and B.

For damage as at (a), drill No. 40 (.098) stop hole; remove damaged area (min corner radii ¼ in.); remove burrs. Provide reinforcing angle (1) of sufficient length to accommodate specified number of rivets. Install rivets in skin attaching leg as per original pattern; number and type of rivets in outsanding leg may be varied for ease of installation and must be specified by authority for repair.

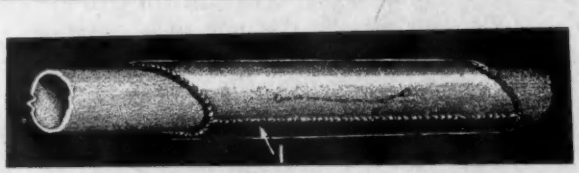


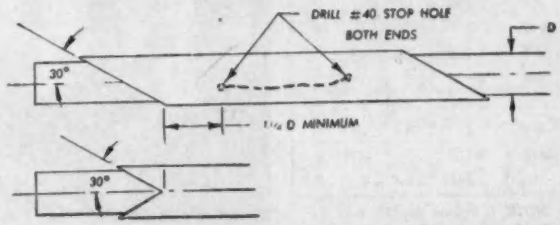
For bulb angles; limited to section thickness of 0.051 in. or less.

To remove damage as at (a above) use method of preceding example. Make a formed reinforcing section (1) of 24SO Alclad; heat treat to T condition after forming; gage, developed width and length to be specified by authority for repair. Installation procedure same as in preceding example.

Damaged Steel Tube Members

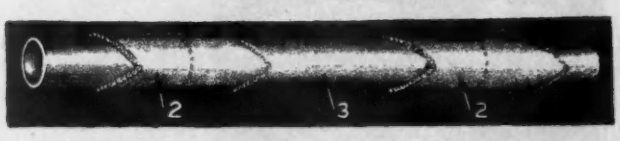
Note: No repair to heat-treated members should be attempted unless proper investigation has been made for effects of welding or reheat-treatment. For member carrying axial loads only. No welded ends are permitted for a length L/8 on each side of midpoint of member, where L is the column length or distance between supports.

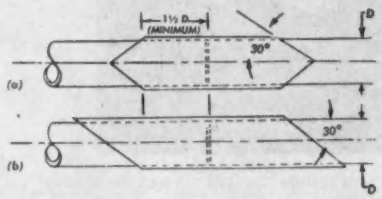




For sharp dents or cracks where extent of damage does not exceed five tube diameters in length and/or one-half tube diameter in width. Where interference by use of Sleeve or damage exceeds limitations, use alternate repair following this one.

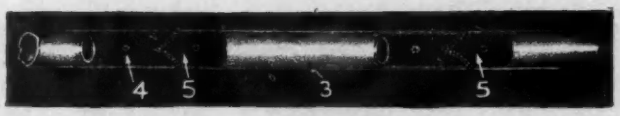
Provide a sleeve (1) that extends a minimum of 1.25D past damaged area at each end; cut entire length of sleeve to form half sections; cut ends at 30 deg or to fishmouth shape. Remove finish of damaged tube sufficient to accommodate repair. Drill No. 40 (.098) stop holes. Clamp half-sections of sleeve in place and weld; clean and finish as per standard practice.

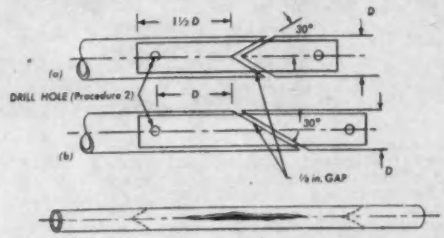




For damage requiring a replacement section.

Provide one replacement tube (3) and two scarfed, snug fitting reinforcement sleeves (2). Sleeve length to be determined with minimum overlap of 1.5D past scarfed ends; recommended length 5D. Remove damaged section and finish of original tube for a distance sufficient to accommodate the repair. Assemble repair parts in place as shown, welding joints along scarf lines; clean and finish as per standard practice. Where sleeves cannot be selected to fit snugly, nearest size tube may be used with rosette-welds fusing sleeves to members.





For damage requiring a replacement section and constant outside diameter.

Provide one replacement tube (3) with scarfed ends, cut to fit area of removed section allowing one-eighth in. gap at joints; and two insert tubes (5) of length determined with minimum

overlap of 1.5 tube diameters past scarfed ends as shown (recommended length 5D). Remove damaged section and scarf the ends; drill 0.25 in. holes in cut ends of original tube and in each end of replacement tube, located one tube diameter from respective ends. For tubes greater than one inch, hole diameter should be one-quarter tube diam, drilled through one side only. Assemble components and rosette-weld (4) in place by fusing to insert tubes through drilled holes. Weld joints along scarf lines, clean and finish as per standard practice.

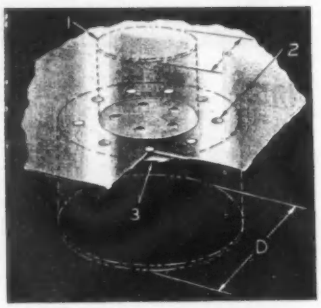
Damaged Thin Aluminum Sheet

Occurring Most Commonly in Skin Covering

TABLE OF REPAIR DIMENSIONS

Plug Diameter d (Inches)	Doubler Diameter D (Inches)	Spotwelds or Rivets Required in Plug		Rivets Req'd in Doubler
		Spots	Rivets	
3/8	1-7/8	3	1	3
1/2	2	3	1	4
5/8	2-1/8	3	1	4
3/4	2-1/4	3	1	5
1	2-3/4	3	1	6
1-1/4	3	4	3	7
1-1/2	3-1/4	5	3	8
2	3-3/4	5	4	9

NOTE: A square doubler may be used: Side dimension to be equal to "D" (optional) Doubler rivets should have circular pattern.

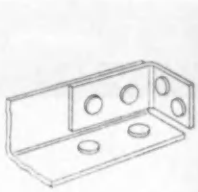


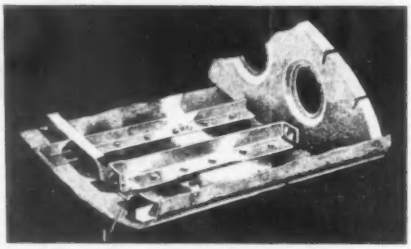
For cuts, "dings" or similar damages; extent of damage limited to a 2.0 in. diam. circle.

Cut and burr a circular hole large enough to remove damaged area (min. diam. ⅝ in.). Make a skin plug (1) to fit cutout and attach to center of doubler (3); AD3 (3/32) in. diam) flush rivets (2) may be used here. Attach plug and doubler to skin.

For general damage limited to not less than 2.0 in. from adjacent structure.

Cut and burr a circular or rectangular (min. corner radii 0.50 in.) hole large enough to remove the damaged area. Fit skin patch (1) to cutout. Make doubler (2) large enough to accommodate rivets with proper edge distance. Rivet doubler to sheet, and skin patch to doubler; use same type, size and spacing as the most closely spaced splice rivets attaching damaged sheet to adjacent structure. Central area of doubler may be removed for weight saving provided width of doubler is not less than twice overlap of sheet. (DimensionW)

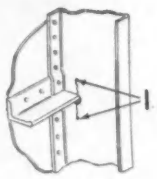


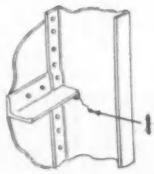


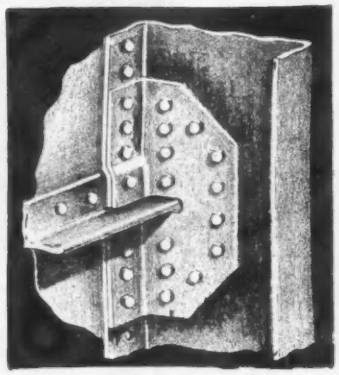
For bulge, or "oil can".

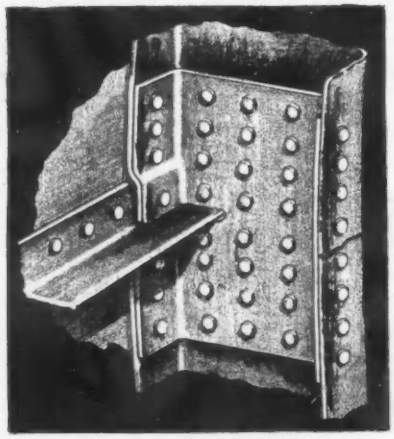
Provide a right angle stiffener (1) (rolled, brake formed or extruded) with minimum thickness one gage heavier than sheet, length sufficient to provide attachment to structural member on either side of "oil can". Attaching clip with provision for minimum of wo rivets may be made a part of brake formed stiffener; otherwise use a right angle clip with a minimum of two rivets in each leg. Locate stiffener across center of "oil can", securing the outstanding legs to adjacent structures. Type and size of attaching rivets to be specified by authority for repair. Where ends of stiffener cannot be attached to adjacent structure, engineering approval is required.

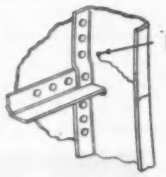
Damaged Formed Channels

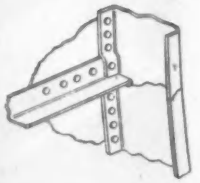








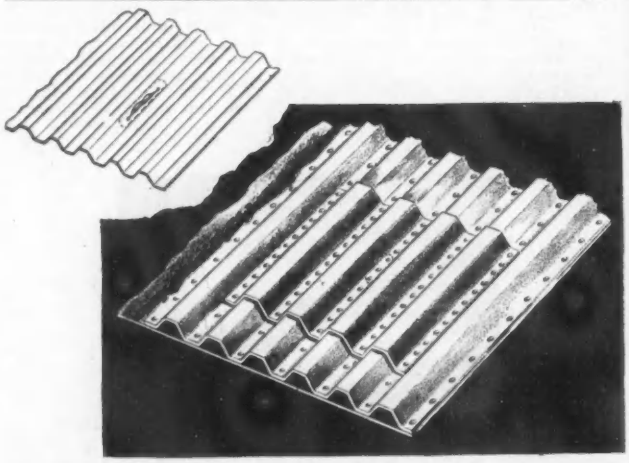




Repair A—For partial damaged sections as used for frames and formers where extent of damage does not exceed one-half channel width. Drill No. 40 (.098) stop holes (1). Make size of doubler equal to damaged area plus sufficient overlap on each end to accommodate specified number of rivets. Form to nest into contour of damaged section. Install by replacing original attaching rivets with longer ones and additional rivets as specified by authority for repair.

Repair B—For partially damaged section where extent of damage exceeds one-half channel width. Follow procedure for repair A.

Corrugated Sheet Repair

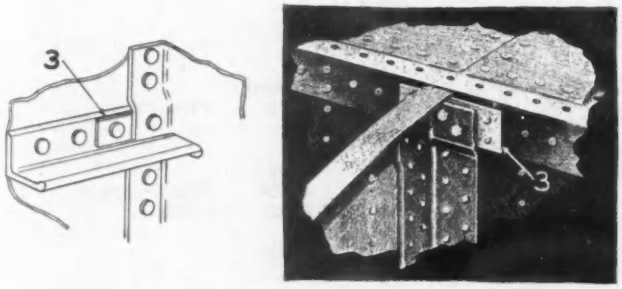


For use where extent of damage is limited to width of two attaching nodes and length of four inches.

Drill No. 40 (.098) stop holes; remove damaged area with minimum corner radii of 0.50 in.; remove burrs. Provide a

formed doubler, material same type and gage as original part, sufficient to overlap damaged area by a minimum of two attaching nodes on each side and to accommodate required number of rivets. Attach to corrugated sheet with original rivet pattern and additional rivets as specified by authority for repair. When damage includes attaching nodes use a shim. Procedure may also be used for spot welded sections.

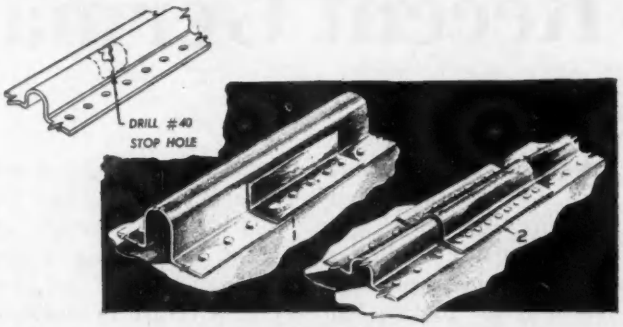
Shimming Attachments



Application at structural attaching points where parts do not make proper contact.

Maximum shim thickness limited to 0.0625 in. Material to be same as adjacent structure, formed to fit mating parts. Shim (3) must be riveted in place, using minimum of two rivets, if joint is not to be permanently attached.

Damaged Hat Sections

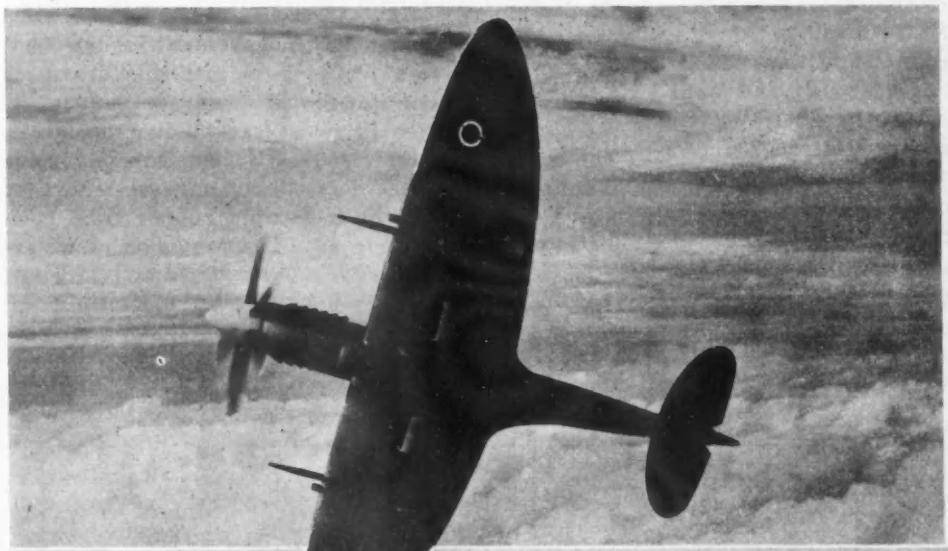


Repair A—For damaged flanges; limited to cracks less than two-thirds width of flange.

Drill No. 40 (.098) stop holes if cracks do not terminate at rivet holes. Provide a formed equal leg angle section (1) of same type material but one gage heavier than damaged part, length sufficient to accommodate specified number of rivets. Form angle to contour of hat section and attach by using original rivet pattern.

Repair B—Alternate to repair A where extent of damage is similar to illustrations.

When damage exceeds 4.0 in. investigation for possibility of replacement is advisable; if necessary to remove one or both flanges shim of same gage and length of removed portion must be used. Drill No. 40 (.098) stop holes; remove damaged area with min. corner radii of one-quarter inch; remove burrs. Provide a reinforcing section (2) (and shim if required), material same type and gage as original part, length sufficient to accommodate specified number of rivets. Attach to hat section by using original rivet pattern plus additional rivets as required. Rivet through sides and top whenever possible.



British Spitfire XIV

BRITAIN'S new Spitfire XIV, a fighter and fighter-bomber, is equipped with a five-bladed propeller, used for the first time in modern aircraft, and the new Rolls-Royce Griffon "65" engine developing over 2000 hp, the combination of which gives this plane a rate of climb unequaled by any other Spitfire and outstanding performance at a ceiling of over 40,000 ft. The Griffon, a pressure cooled 12-cylinder V-type engine, was described in the May 1, 1944, issue of AUTOMOTIVE AND AVIA-

(*Turn to page* 98, *please*)

Recent German Developments

ARTICLES have appeared in the German publication *Luftwissen* describing the Weibel method for welding light-alloy sheets and the development of miniature arc-welding equipment for joining wires. The following descriptions are from translations provided by the British Ministry of Aircraft Production.

Weibel Method

This is an indirect-resistance electric welding process for joining light-alloy sheets up to 0.078 in. gage that can be applied to all alloys capable of autogenous and atomic arc welding. From the welding unit comprising a 220 or 380 volt a-c transformer and multi-stage controller, two welding cables lead to the electrode holder carrying two carbon electrodes. When the tips of these electrodes are brought together, one on either side of the raised flanges of the sheet to be joined, the welding circuit is closed. The consumption of energy for this purpose is exceptionally low, i.e. in the region of 50-260 amps at a welding potential of 3.5-8.0 volts.

Tests of the optimum electrode shape were made with copper-sheathed carbons of 0.39, 0.71 and 1.18 in. diameter, in three grades of hardness—soft, medium and hard. Medium and hard electrodes stood up to the work best, while the highest electrical efficiency was shown by electrodes of 0.71 in. diameter. As will be seen from Fig. 1A, the carbons have a maximum length of 7.87 in., of which from 2.0 to 2.75 in. should project beyond the holder. The front rake (Fig. 1B) should not be more than 15 deg. It has also been found beneficial to set the electrodes at 20 deg apart, in the direction of the weld, with a maximum side rake of 30 deg. The tip is also backed off slightly on the edge nearest the work.

The early electrode holders were of the general type shown in Fig. 2, the welding cables being led along each arm of the holder, by the side of the hand grips, to the electrode clamps. Heat radiation from such uncooled electrode holders becomes inconvenient for the operator. The Junkers Werke have met this drawback by designing a water-cooled electrode holder resembling that used in resistance-welding machines. The cables with their cooling jackets are led inside the handles to the electrode clamps, the jaws of which are bridged by a flexible rubber tube completing the cooling circuit. The provision of water-

Table 1—Standard Values for Forming Flanges

Sheet thickness, in.	Flange radius, in.		Flange depth, in.
	Tempered stock	Annealed stock	
0.012	0.039	0.024	
0.017	0.039	0.024	Sheet thickness
0.020	0.059	0.024	+0.098 in.
0.024	0.059	0.039	
0.031	0.098	0.039	
0.031	0.098	0.039	
0.039	0.098	0.062	Sheet thickness
0.047	.157	0.059	+0.118 to 0.157 in.
0.059	0.157	0.098	

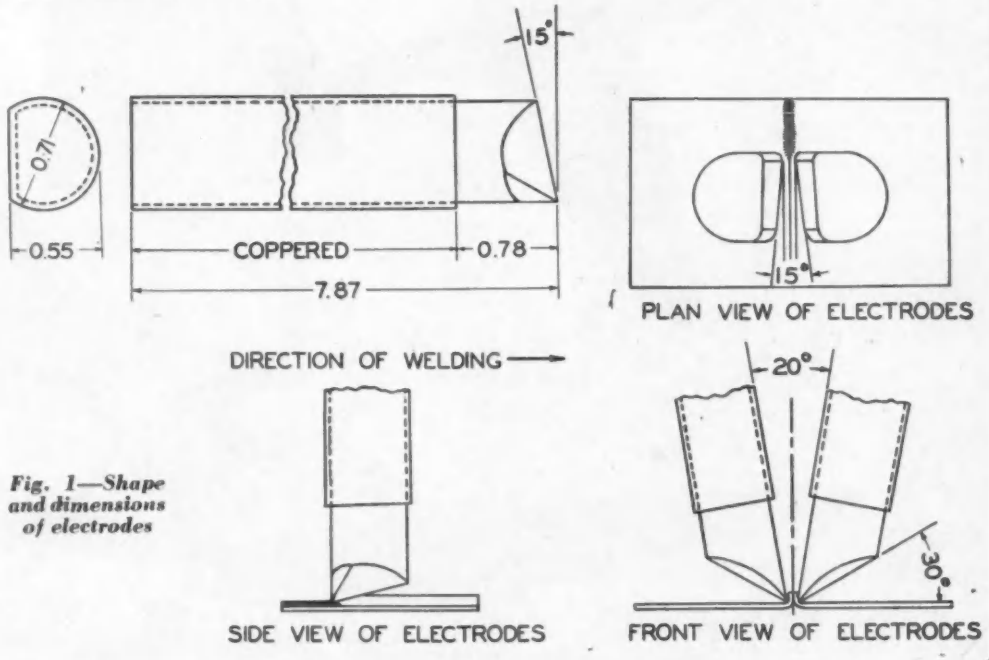


Fig. 1—Shape and dimensions of electrodes

in Electric Welding

By M. W. Bourdon

Special Correspondent of AUTOMOTIVE *and* AVIATION INDUSTRIES in Great Britain

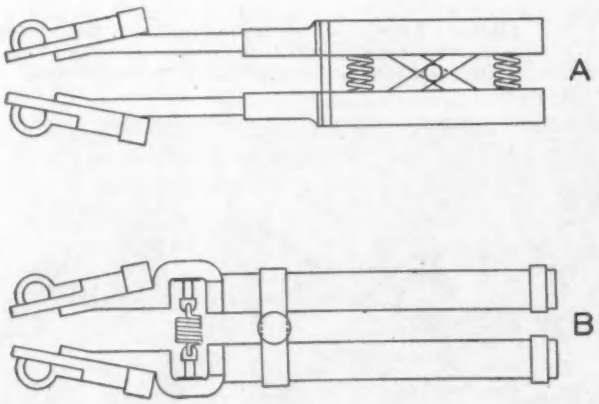


Fig. 2—Electrode holders
A—Manually closed holder
B—Holder closed by tension spring

cooling has justified a reduction in the cross section of the welding cables, so reducing the total weight of the holder.

In early versions of the Wiebel process the holder was drawn along at an even rate, producing a smooth seam. Junkers developed a system of "back-step" or "Weibel-vibratory" welding. In this, an out-of-balance mass is incorporated in the electrode holder, e.g., in the cooling water circuit, by which the welding bead is laid in steps of about 0.12 in. in length. If a seam about 3.0 ft long is welded by a continuous bead the electrode tips become increasingly contaminated by oxide particles floating on the melt. In the back-stepping process the vibrating motion of the electrode holder prevents the melt from forming accumulations. Welds on .008 gage sheets, impossible by the autogenous process, can be carried out by this method without difficulty.

The preparation of the work and accurate fitting of the parts require closer attention than in other welding processes. The usual welding pastes are suitable. With the standard electrode tip the material should be flanged to 90 deg, but the depth of flange depends upon the thickness of the material. Standard values are given in Table I.

Miniature Arc Welding Equipment

The scarcity of tin for soldering and the need to speed up production in joining wires of precision instruments motivated Siemens and Halske to develop and standardize three sizes of miniature welding appliances. The smallest is intended for handling fine and ultra-fine gage wires, i.e. from 0.0008 to 0.020 in. diameter. The largest size can deal with wires up to 0.015 sq in. cross sectional area, while the medium size is described as intended for workshop use to handle a wide range of wire of different gages. Each appliance consists of a transformer, working off a 220 or 110 volt supply, and the welding tool. Fine wires are welded with a so-called vibrating electrode (Fig. 3), while for heavier duty a "welding pencil" is used. (See Fig. 4, page 98).

The vibrating electrode consists of an interchangeable carbon attached to a steel reed vibrating in unison with the alternating current supply. Interposition of a capacitance in the mains connector in front of the vibrator coil ensures that the arc is struck only at the instant when the voltage between the electrode and the job has been built up to the value required for making the weld. The second electrode is formed by the work itself, which is gripped in a holder connected to the mains unit.

The welding pencil is composed of a welding head and an insulating sleeve surrounding a carbon rod and a magnetizing coil. The arc is struck by pressing a button on the insulating sleeve. The

(*Turn to page* 98, *please*)

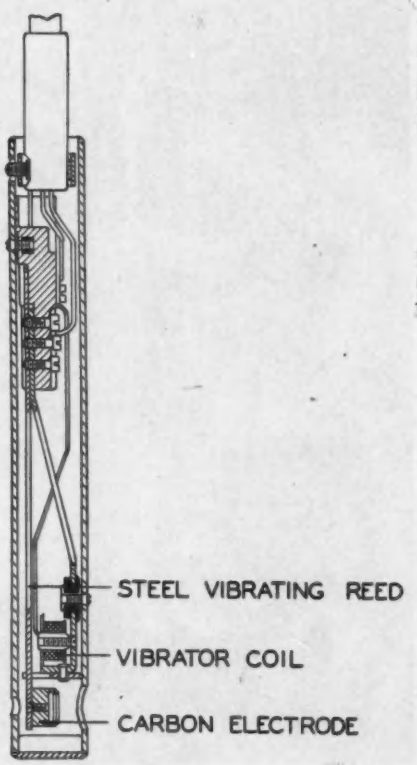
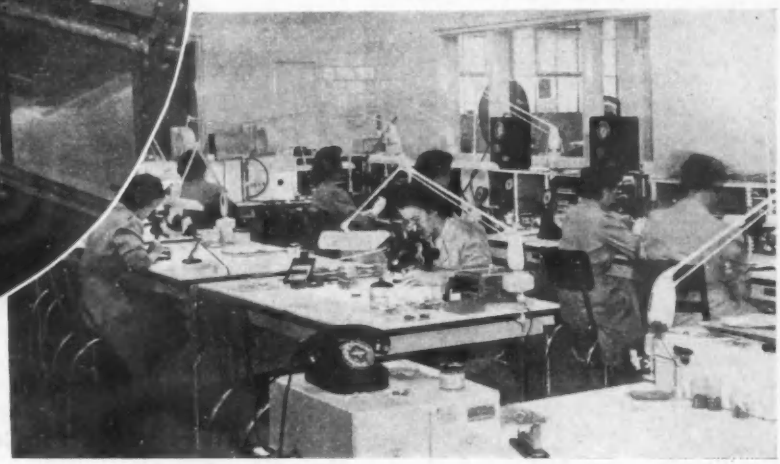


Fig. 3—Sectional view of the vibrating electrode welding tool

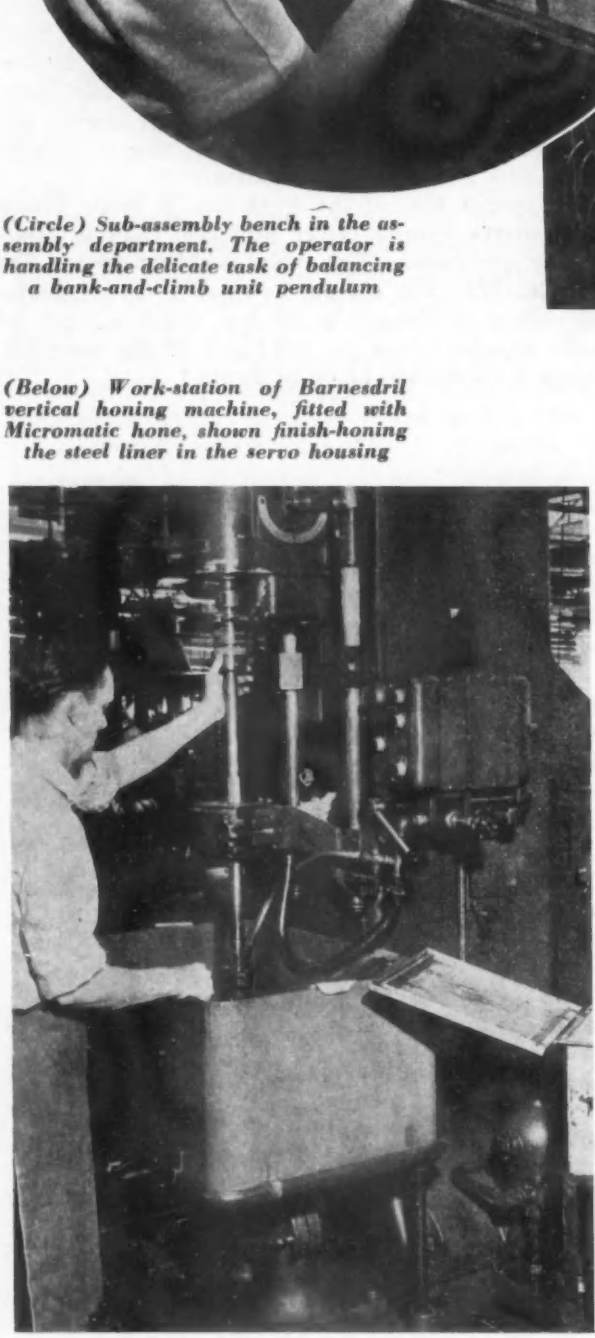
Gyropilots

(Circle) Sub-assembly bench in the assembly department. The operator is handling the delicate task of balancing a bank-and-climb unit pendulum

(Below) Interior of tile-walled and porcelain-fitted inspection room for ball bearings. Here the bearings are washed, cleaned, oiled, and assembled



(Below) Work-station of Barnesdril vertical honing machine, fitted with Micromatic hone, shown finish-honing the steel liner in the servo housing



BEFORE the War many instruments and scientific devices were required in such small quantity that they were produced entirely with hand methods by skilled craftsmen. The suddenly accelerated demand for many of these units by the armed forces found manufacturers unprepared to undertake quantity production. Among such items was the Sperry Gyropilot. Formerly made by tool room methods, the demand for outfitting military aircraft posed the problem of establishing their manufacture on a production basis.

This program was undertaken by the Electric Auto-Lite Co., which established its Aviation Division for the purpose. Although precision-made products were not new to Auto-Lite, it was realized that the mass production of these instruments was quite beyond the scope of ordinary commercial practice. With the inception of the project, Auto-Lite had the advantage of the engineering and practical experience of the Sperry organization. Its major contribution to the art was the development, from scratch, of job-lot production methods in keeping with the volume required; and in training a force of unskilled labor, particularly women who had never had industrial experience of any kind.

The job was done with exceptional skill stemming from years of experience as a producer of automotive electrical products. The Aviation Division was housed in a modern one-story building, erected for the purpose. It was provided with the most modern machine tools selected for the needs of the various operations. The important point is that fixtures and tooling were so designed as to make each operation fool-proof,

in Quantity *Production at Auto-Lite*

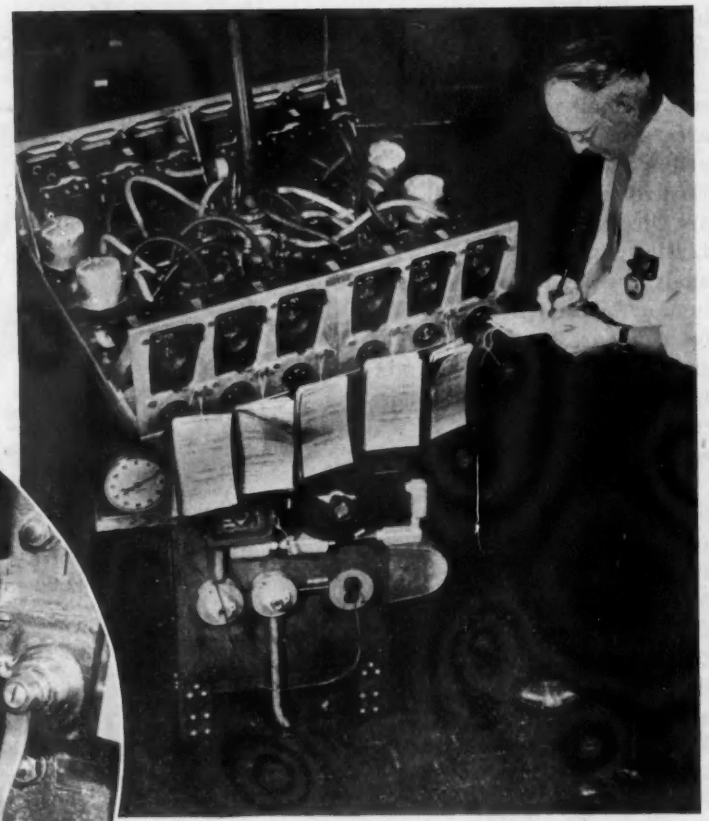
transferring the skill from the operator to the machine. By these means the unskilled workers could be trained simply to load and unload the work without affecting precision to any extent.

The plant is laid out for straight line flow of parts from the machine shop to the assembly department. Among the major departments are: general machine shop, screw machine, automatic and turret lathe, drill press, heat-treating, electroplating, bearing inspection, sub-assembly, final assembly. Among the machinery found here are Brown & Sharpe grinders, Cincinnati Centerless grinders, Cincinnati milling machines, Kent-Owens mills, South Bend lathes, W & S turret lathes, 6-spindle Conomatics, New Britain-Gridleys, National Acme-Gridleys, Sunnen honing machines, Micromatic honing machines, etc.

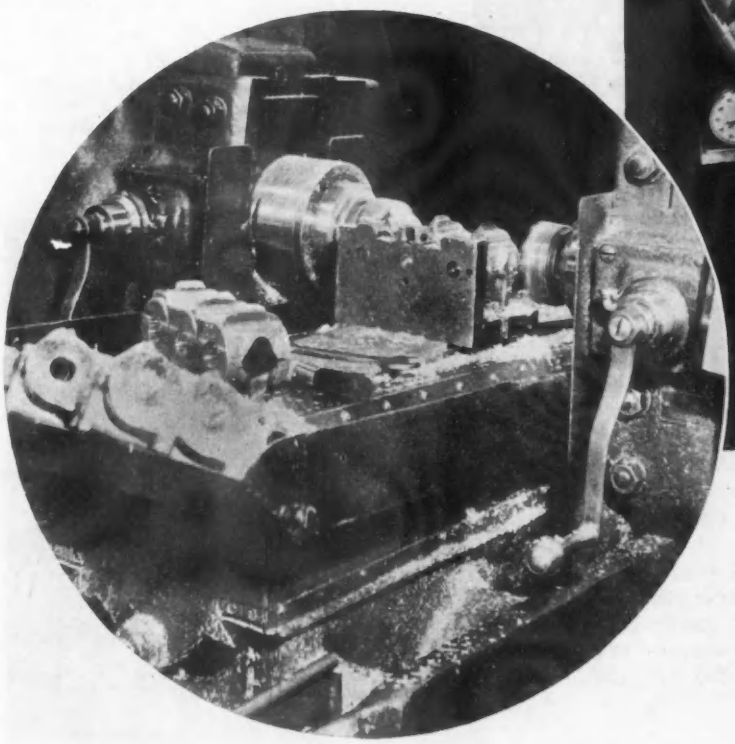
Precision is the key to the operation—precision in manufacturing, great care in assembly, unusual precautions as to cleanliness. While it would be difficult to define the limits of precision without actually showing details of individual parts, it may be said as a generalization that most bores and ground diameters are held to 0.0002 and 0.0003 in. It must be appreciated that, although the actuating forces within the instruments are of the order of "flea-power," response must be instantaneous and the signals of utmost fidelity. The life of military personnel as well as the safety of valuable equipment hinge upon the performance of these instruments.

Consequently, the assembly operations have almost impossible specifications imposed upon them. Small gear trains must be assembled without back-lash and, also, without friction. Ball bearings, most of them smaller than any used in ordinary mechanisms, must be nearly frictionless. This sort of process extends

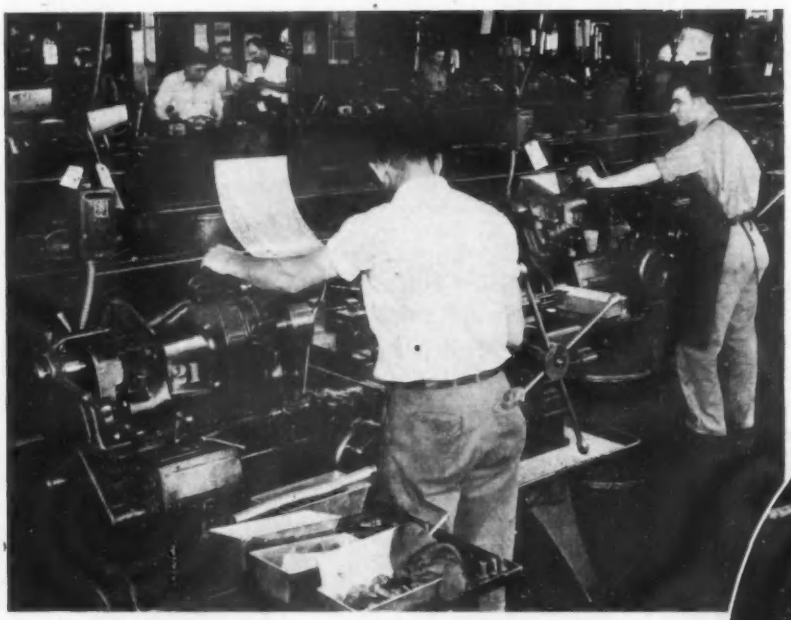
By Joseph Geschelin



(Above) Among the final inspection operations in the assembly department is the testing of instruments for roll, pitch, and yaw on Scorsby machines such as the one shown here

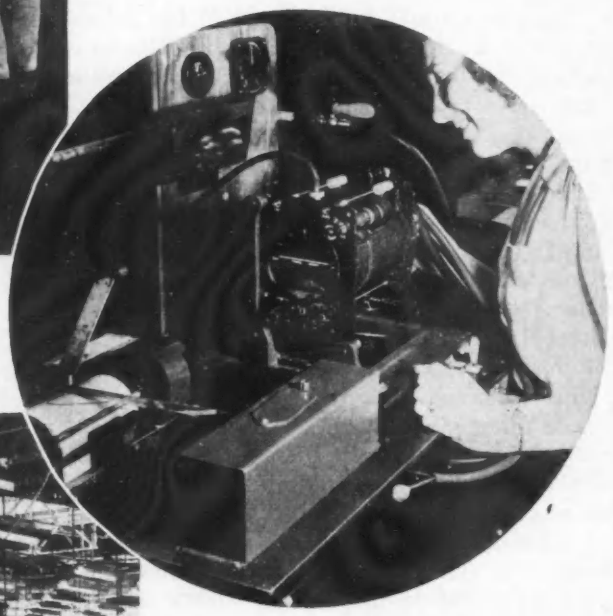


(Circle) Work-station of a Cincinnati Duplex milling machine. This shows the milling of the non-ferrous transfer valve housing



(Left) Part of a large battery of versatile South Bend lathes and hand screw machines

(Circle) In the final inspection department—calibration of valves in the bank-and-climb unit. At the left may be seen the indicator card record which is produced for each unit and retained for analysis and file

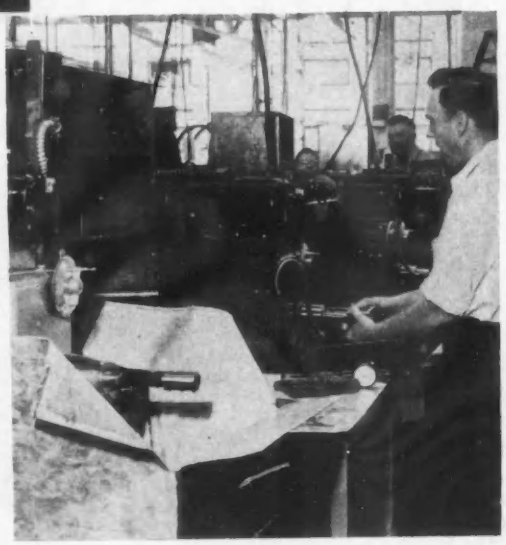


to every element of the assembly. No back-lash—no friction—perfect balance.

Quality control is tailored to suit. Small ground diameters are checked with Sheffield gages and with the P & W Electrolimit gages; small bores are checked with P & W Air-O-Limit gages; Brush surface analyzers are used for inspecting surface finish; J & L Comparators are employed for the checking of contours. In addition, optical flats and laboratory micrometers are considered routine production tools.

(Left) Interesting paint spray and drying unit is composed of a small DeVilbiss spray booth, served by a monorail conveyor for transporting work through the infra-red lamp baking unit in the center

(Below) Among the special equipment items found here is a large battery of Sunnen honing machines which are used for a variety of small-bore honing operations



Honing is used on small bores—the operation being performed on a battery of the familiar horizontal Sunnen and Micromatic honing machines. On the transfer valve in which the bore is broached, a steel liner is pressed in and then honed on a Barnesdril vertical honing machine fitted with Micromatic hones. Gyro rotor bearing pivots are lapped on special machines to perfection. Certain flat surfaces also are lapped. Cemented-carbide tips are used in milling cutters for machining aluminum and magnesium parts. One of the major of such operations is the milling of magnesium housings in a Cincinnati Duplex mill; another is the profiling of the housing pads on a four-spindle Cincinnati Hydro-Tel.

The heat-treating department, by the nature of the job, is small and is outfitted with small units of equipment. Among the furnaces found here are Surface-Combustion Conjecto furnaces and L & N Vapocarb furnaces. All of the furnaces are provided with recording pyrometers for precise control of time and temperature.

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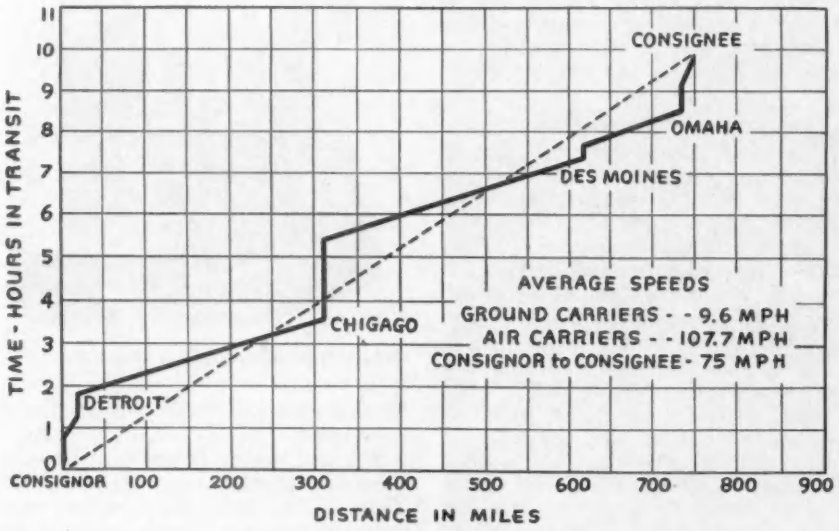
Timely Papers *Presented at* T&M Meeting *of* SAE



Typical air express shipment of automotive parts from Detroit to Omaha.

COORDINATION of air and ground transport, surface and helicopter buses, wartime motor fuels, future gasoline engines and Diesel engine applications were among the subjects discussed in papers at the National Transportation and Maintenance Meeting of the Society of Automotive Engineers in August at Portland, Ore. Abstracts of papers are presented herewith:

Air Cargo, a Problem of Cooperation between Carriers on the Ground and in Flight

By R. D. Kelly, Supt. of Development, United Air Lines, Inc.

THE principal justification for air transportation, whether for passengers or cargo, is its speed advantage over ground transportation. Generally speaking, all air transportation must be supplemented with ground transportation, and thereby becomes an integral part of the overall distance and time equation. The basic fact that much more thought and effort is justified for ground handling of air cargo than for cargo that is to be transported entirely via surface vehicles must be realized by ground handling organizations and carriers if they are to do their part in an effective, efficient air transportation system.

The chart on this page is a typical example illustrating these points. The straight line between the origin and the end of the graph is the average rate of speed made good by the product. Vertical lines denote waiting time. A study of this chart will reveal where service can be expedited through more efficient handling by the carriers. Extended studies demonstrate that the air carrier makes his maximum contribution on the longer distances. Frequency of service by both carriers is essential in order to take advantage of the air carriers' delays in transit.

There is a current fallacy that a slow airplane, one with a large wing area, should be able to transport cargo at a cost to compete with surface carriage. This is not true, except for cases where the cost of construction of highways and the greater length of routes overbalances the cost formula so that the airplane has an advantage due to its ability to operate directly between two airports, regardless of the intervening terrain. Wherever good roads or rail facilities exist, slow moving vehicles should not fly, but should remain on the ground. For the same speed and weight of vehicles, the "rolling resistance" or "drawbar pull" for a wheeled vehicle operating on a good highway or on rails, is only a fraction of the "drag" required to pull an airplane through the air.

The accompanying table shows comparisons between typical truck and actual (DC-3) and theoretical (items 1 and 2) cargo planes. A comparison of items 1 and 2 indicates how impractical the slow airplane would be. Item 4 is indicative of what can be expected in new designs. The distance will be approximately 1600 miles non-stop in a little over 6 hrs flying. This represents a pay load at 3 1/3 times that of the truck, carried at 4 1/3 times the speed, and for a non-stop distance which would be beyond the comprehension of the truck operator.

These comparisons should serve to emphasize the fact that there can be no direct competition between the carriage of cargo by air and by surface transportation. There seems to be no possibility, in the immediate future, that surface carriers can approach the speed wherein the aircraft begins to operate at its most economical figure.

Comparisons Between Typical Truck and Actual and Theoretical Cargo Airplanes

Vehicle	Gross Weight (Lb.)	Useful Load (Lb.)	Payload (Lb.)	Maximum Hp.	Cruising Speed (Mph)	Cruising Hp.	Wing Area (Sq. Ft.)
1. Slow Airplane	25,000	200	0	835	60	450	3100
2. Truck	25,000	14,000	13,500	110	60	110	.....
3. DC-3	25,200	8,500	6,800	2,400	185	1200	1000
4. Modern Airplane	160,000	68,000	45,000	14,000	260	7800	3100

Surface Buses of the Future

By W. W. Churchill, Washington Motor Coach Co.

AN INTERCITY motor coach is the result of a compromise between the sales and engineering departments of the manufacturers and of the coach operators. The engine, without question, is the most important unit in a coach whether it be Diesel or gasoline. We started using Diesel-powered equipment 3½ years ago and since that time have operated 6,500,000 miles with this type power. Comparing Diesel with gasoline units in the same size equipment, operating over the same territory, in long distance intercity service, our Diesel-powered coaches for the entire year of 1943 operated at a saving of 1.78 cents per mile for fuel cost alone. The same fuel tax applied to both fuels. Lubricating oil costs were 0.14 cents per mile higher for Diesel equipment. Total engine maintenance

(*Turn to page* 70, *please*)

New Production Equipment

NORTON COMPANY, Worcester, Mass., has acquired all design and mechanism patents, copyrights, drawings, and all manufacturing and sales rights pertaining to the Bura-way grinder. This tool and form grinding machine, which will in the future be manufactured and sold under the name "Norton Bura-way," provides a

Norton Bura-way grinder

means of forming constant relief in the direction of feed on metal cutting tools. Added factors which will contribute to longer tool life include means of precise control in grinding tool angles, close control of the amount of metal removed in renewing cutting edges, reproduction of form tools within close dimensional limits, and the production of a fine surface finish at the tool's edge.

Relief angles are said to be controllable within minutes of arc. The unit, now equipped for wet grinding, is equally suited to the rough or finish grinding of tools, handling high speed and cast-chromium cobalt steels as well as carbide tipped tools.

ADDITION to its standard stock tool line of a series of Carboloy Cemented Carbide tipped tools designed for Jones & Lamson roller turners has been announced by Carboloy Company, Inc., Detroit, Mich. These are in addition to tools for Warner & Swasey and Gisholt roller turners previously available from stock.

The new standardized J & L roller turner tools range in size from ⅜-in. by ½-in. shank size to 1-in. by 1¼-in. shank. The tools are regularly furnished with tips of 78B steel cutting grade of Carboloy cemented carbide.

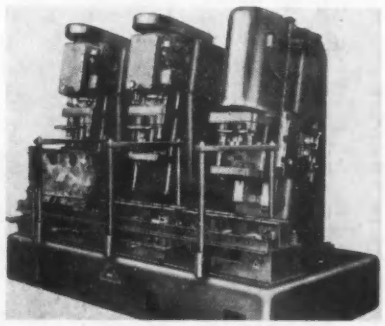
A SPECIAL-PURPOSE machine, manufactured by Snyder Tool and Engineering Co., is built up of standard units to serve the purpose of two machines by providing for interchangeability of multiple heads and bushing plates. It is used for drilling two different axle housings and incorporates three Snyder standard guide-bar type, self-contained hydraulic units.

The two end units are equipped with interchangeable multiple heads and bushing plates, each set of which is used on but one of the two different axle housings. The rear unit carries a 14-spindle multiple head in which 10 of the spindles are used on one part and 4 on the other. Only the tools to be used—either 10 or 4—are set up at one time. Drill guide bushings for the rear tools are installed rigidly on the fixture.

The fixture consists of three sections—a center locating and clamping fixture and two end sections. Each end section has a V-block and clamp to position the work-piece accurately on a horizontal center line. The motors mounted on top of the units provide power for the multiple heads and for the hydraulic pumps within the units.

HOLES in truck cylinder blocks can be rough drilled through the solid casting, then semi-finished and finish-reamed, all in one cycle, on a large three-station machine developed by LeMaire Tool & Mfg. Co., Dearborn, Mich.

By being conveyor indexed, the machine provides a progressive setup that eliminates much handling of heavy parts from one machine to another. The first station is used to drill four holes through the solid surface of the casting. One of the holes is also counterbored and spot faced to 2⅜ in. diameter. The second station, equipped with a four-spindle head, semi-finish reams the holes. The third station



LeMaire three-station machine

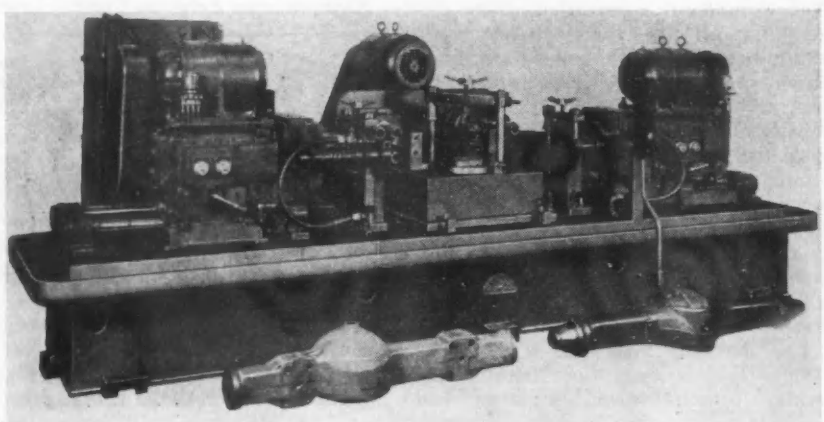
finish-reams two 1¼-in. holes and two 2-in. holes.

The drill heads in the first two stations are driven by standard No. 5000 Twin Ram hydraulic power units mounted at a ten degree angle on the face of the columns. The third station has a sliding type unit that slides on machined ways 63 in. long, 4 in. wide, spaced 16 in. apart. All four holes are completed in one casting every time the machine cycles.

A NEW ground clamp for welders has just been announced by The Lincoln Electric Company, Cleveland, Ohio. The clamp is designed so that each jaw connects independently to the ground cable. Thus, if one jaw is prevented from making a good electrical contact, due to any reason such as heavy scale, paint, etc., the other jaw will carry the current.

The ground clamp has a heavy-duty processed steel frame with durable copper conductors and contacts. The

(*Turn to page* 56, *please*)



Snyder special-purpose machine

READY TO TACKLE *YOUR* PROBLEMS *with* OIL HYDRAULICS

You'll find the evidence all about you—oil hydraulics is moving rapidly into almost every phase of the industrial picture. It is setting a fast pace for new and improved ways of getting things done *better*. If you haven't already had occasion to note this trend, or to take advantage of it in your wartime production, your postwar planning will bring it sharply into focus.

The *reason why* hydraulic power is so much better for so many jobs is simple enough: oil under pressure can be applied to almost any power need to give *stepless* speed variation; *constant* speed control; shockproof starting, stopping and reversing; *direct* and *instant* control of power or movement; *uniform* power in any direction, in rotation, or in operating sequences; many other similar advantages.

Knowing *how* to apply oil under pressure to achieve the right combination of advantages for each job is not quite as simple. But Denison HydrOILic Engineers have solved so many new problems in this field — for so many different industries and over so many years — that they have reduced this important "know-how" to an almost exact science.

In making these technical advances, Denison has proved the advantage of *complete oil hydraulic service,* from expert analysis of individual requirements to installation and initial operation of the HydrOILic equipment that meets them.

You are invited to avail yourself of this specialized experience. No matter how vague or how concrete your immediate and postwar planning may be, now is the time to begin discussing HydrOILics in terms of your particular needs. Write today.

The DENISON Engineering Co.
1178 Dublin Rd., Columbus 16, Ohio

HUNDREDS of production jobs and special operations are handled with HydrOILic Equipment — in wartime and peacetime industry alike. Among these tasks are assembling, straightening, broaching, conveying, extruding, crimping, loading, lifting, handling, hauling, hoisting, tilting, testing, turning, pushing, pulling, packing, pressing, indexing, rotating. Let Denison Engineers help you determine how, and HOW MUCH, HydrOILics can help you.

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Factors Back of Demand for Revision of L.S. Formula

Two WLB Panels Say That Living Costs Have Risen 25 to 43 Per Cent Above Jan., 1941-May, 1942, Level

Upward revision of the Little Steel wage formula appears in prospect following the report of two WLB panels that living costs have risen 25 to 43 per cent above the Jan., 1941-May, 1942, level, base period of the present Little Steel formula. The findings of the panels have cleared the decks for WLB hearings on the question and the week of Oct. 9 has been set for executive sessions to consider the results of hearings held Sept. 26 to 29. Following the executive sessions, the issue probably will be placed in the hands of President Roosevelt, since the board has power only to review the facts and to make recommendations.

The panels have criticized the Bureau of Labor Statistics cost-of-living index as faulty, stating that it does not take into consideration the full wartime effect on the cost of living of such factors as lower quality merchandise, disappearance of low-cost goods, and forced changes in housing and eating away from home.

One of the panels, investigating the demands of CIO steel workers for a 17-cents-an-hour pay hike, held that living costs have risen at least 10 to 25 per cent above the 15 per cent adjustment provided by the present formula, that there is no evidence that Congress intended subsequent increases in cost of living should not be considered, and that the steel industry can afford to increase wages without falling below the 1936-39 profit level. A second panel dealt with the merits of demands by the AFL that the Little Steel formula be modified in view of increased living costs. In addition to the steel case, there are 11 cases pending before the board, dealing with pay boosts, guaranteed annual wages, termination and sick pay, and other wage liberalization measures. Before the executive sessions are held, industrial association, including the National Association of Manufacturers and the United States Chamber of Commerce, will have their day in court. Industry members on the panels already have filed a minority report setting forth that wage increases will increase the consumer purchasing power to a point where the whole national economic stabilization program will be imperiled.

A major argument put forth by labor is that with the 40-hour week in prospect after the war, hourly rates must be kited to maintain at present levels the weekly "take home" pay for the 48-hour week, which, with overtime, actually amounts to pay for 52 hours. Such a raise would amount to nearly 25 per cent. This increase, if attained, may have a significant bearing on prices of postwar products. For example, current prediction on postwar passenger car prices range from 20 to 25 per cent above prewar levels, predicated on present wage scales. However, if hourly rates are boosted to give the same pay for 40 hours work that now is paid for 48, the labor cost per car will be higher because fewer cars will be built in the shorter work week. As a result, postwar prices undoubtedly would have to be raised higher than current predictions. There is as yet, of course, no indication that wage increases will allow the same pay for 40 hours that now is paid for 48. The steel panel pointed out that if production is reduced by the 40-hour week, initial cost of production will decline because the unit labor cost will go down because of elimination of overtime premium pay. Going to a 40-hour week would reduce production 16 2/3 per cent, whereas labor costs would decline 25 per cent, leaving an 8 1/3 per cent differential in favor of industry. Consequently, if wage boosts are held to this 8 1/3 per cent, rather than the 25 per cent which the unions are requesting, present labor costs will prevail.

At the UAW-CIO annual convention in mid-September, surprisingly little was said about wage increases. Apparently, union officials were letting the Administration carry the ball, since the WLB report and its favorable comment, was announced during convention week. It also is noteworthy that just prior to the announcement, Philip Murray, CIO president, told the convention that the Little Steel formula would be abandoned. The stormiest debate at the conclave, which was marked by the recurrent rebellions against union leaders by a "rank-and-file"

(*Turn to page* 52, *please*)

Large Scale Production Of Helicopters Begins At Nash-Kelvinator Corp.

Nash-Kelvinator Corp. has completed test flights of a new type helicopter and is getting set to apply automotive assembly line methods to mass production manufacture of "countless numbers" of the new aircraft, according to George W. Mason, president.

Developed jointly by the Army and Navy, the helicopter is designated as the R-6. It is the single rotor type, having three blades with a tip-to-tip diameter of 38 ft. The auxiliary tail rotor, which acts as a rudder, has three blades with a tip-to-tip diameter of slightly more than 7 ft.

Powered by an air-cooled 245 hp Franklin engine which drives both main and tail rotor, the R-6 has a top speed of more than 100 mph and will climb to 4000 ft in less than 7 min. A drive shaft and transmission mechanism directly above the motor connects it to the rotor head and the three main blades which give the craft lift and lateral flight. Control is provided through alternation of the pitch of the blades, with directional control provid-

(*Turn to page* 52, *please*)

R-6 Helicopter

The first helicopter to be built by Nash-Kelvinator on assembly lines in its Detroit plant takes off from the Company's airport on a test flight.

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Just two fingers turn the steering wheel and the front wheels follow *exactly* . . . the Vickers Hydraulic Power Steering System does the work instead of the driver. And this heavy truck steers just as easily over rough ground as on smooth pavement. No shock load can be transmitted from the front wheels back to the steering wheel . . . thus relieving the driver of considerable fatigue resulting from constant road shocks he must absorb with the conventional mechanical steering gear.

Among the many other advantages of Vickers Hydraulic Power Steering are: easy application to existing chassis designs, automatic overload protection for both steering linkage and hydraulic system, wheel "fight" is impossible, automatic lubrication, and 14 years of successful operating experience on trucks, buses, road machinery, etc. For all the facts about Vickers Hydraulic Power Steering, ask for the new Bulletin 44-30.

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No Decisive Change Indicated by Slight Decline in Steel Output

Most Contractors, However, Are Holding Down Inventories of Materials Useful Only for War Items

By W. C. Hirsch

Sentiment more than computable figures and data dominates ideas in the steel market as to the length of time that is likely to elapse before war material contracts will definitely wane in importance. The Army's statement that X-day, the date when the final defeat of Germany is accomplished, would probably permit a 37 per cent lessening of military requirements, doesn't come in for as much consideration in production planning as do the "hunches" of some policy-making executives. Through it all, however, runs the admonition not to permit any relaxation of the effort to supply the armed services with all the war material they might stand in need of under the most critical conditions. There hasn't been any downward change in steel mill output of such proportions as to justify the conclusion that it resulted from preparations for more and more cutbacks. Considering the continuing manpower shortage, the decline in the rate of steel mill operations to around 95 per cent of theoretical capacity can hardly be taken to denote any sort of decisive change. There is, however, in evidence a perfectly natural desire on the part of war contractors to hold down as much as possible inventories of materials that foreseeably might only be of advantageous use in the production of military and naval items.

Recent revision of CMP regulations is interpreted as aiming at speedier disposal of certain surplus NE steels. Under the title of "spot authorization plan" it is also hoped by WPB executives to map out a plan that, when reconversion becomes an actuality, will assure to smaller steel buyers a fair supply, so as to put them on an equal footing with their larger competitors, whose commitments might come in for preferred treatment. In so far as their paper stage permits, plans for the resumption of steel buying by automobile manufacturers are being rounded out, so that when the gong sounds, little time will be lost in preparatory conferences of automotive engineers and steel mill metallurgists. Contrary to the belief held in some quarters that the changeover from chiefly military requirements to production for mainly civilian end-uses would upset orderly sheet rolling mill schedules to an alarming extent, it is pointed out that much of the tonnage on books and in work could be switched over to the rolling of automobile sheets and similar descriptions of flat steel without any trouble. Automobile sheets call for higher finishing than has been necessary in the general run of heavy hot rolled sheets for ordnance purposes, but little difficulty is expected from necessary adjustments of this character. The adaptability of rolling mills is perhaps best illustrated by the recent announcement that a steel company succeeded in precision rolling of magnesium and is now turning out thin magnesium sheets on a production basis.

Negotiations aimed at obtaining a better price than 60 cents a pound for Bolivian tin have been stepped up as the result of the presence in the United States of Mauricio Hochschild, head of the second largest tin mining company in Bolivia. It is interesting to note that some tin merchants are convinced that the Japanese have been operating the tin mines of the Dutch East Indies ever since they captured this dominion of Queen Wilhelmina and there are those who believe that the wily Nipponese have built up a stock of tin in excess of 50,000 tons.

DOD Offers to Sell Standard Machine Tools

In the first move of its kind by any of the branches of the armed services, the Detroit Ordnance District has agreed to sell 25,000 to 30,000 standard machine tools which it owns to the automobile industry. The machines, now in use on war contracts in Michigan plants and estimated to be worth approximately $100 million, will be sold to any contractor in possession at prices set up under the Clayton price schedule.

Either prime or subcontractors using the tools can apply to DOD for its purchanse on a standard form. The only stipulation attached is that the machine is to remain on the war job to which it is assigned until the contract is either completed or terminated. The agreement to sell the tools is the result of several months' work by the Detroit Regional WPB. Officials of the agency have expressed hope that the move will lead to similar action by other service branches which own or control machine tools in the area.

Nash Plans to Triple Prewar Output

Plans for a postwar automobile building program based on production triple that of prewar output have progressed at Nash-Kelvinator Corp. to the point of having all initial supplies and parts under order and much of the required machinery ready, according to George W. Mason, president. He states that unpredictable factors will affect the time required to get into production after reconversion day, but that most car manufacturers believe they can turn out new cars in 90 days, plus —the plus being for potential machine or supply bottlenecks.

Nash will make its play in the low and medium priced fields, featuring cars with the internal-strut body construction that eliminates the conventional sub-frame, Mason said. The company had developed and introduced a car of this type before the war.

Machine Tools Are Number 1 Reconversion Problem Facing the Automotive Industry

Difficulty in obtaining the key machine tools needed to build automobiles is the Number 1 reconversion problem facing the automobile industry, according to Charles E. Wilson, president of General Motors Corp., who outlined G.M.'s postwar problems and plans at a press meeting in Detroit, Sept. 12. He stated that the industry placed its orders soon after WPB authorized such action Aug. 15, but that since the orders are unrated and since the machine tool industry is tied up with priority orders and war work, no satisfactory delivery promise has been forthcoming.

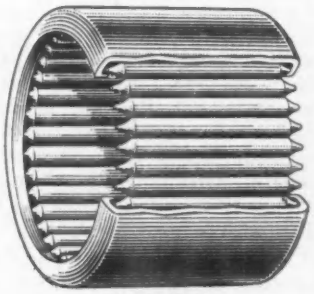
Two other problems also are major obstacles in the path of a quick reconversion, he said. One is the clearing of plants of government-owned machinery, tools, and inventory, and the other is the lack of enough draftsmen and engineers needed to draw up materials specifications for supplies. He pointed out that some materials still are in short supply and that substitute materials must be tested to determine their suitability for car manufacture.

The corporation will need about $25 million worth of new tools Wilson said. He added that a certain number of machines have to be obtained before factories can turn a wheel on production. Division heads attending the meeting reported that Buick is short 310 critical machine tools, Oldsmobile 352, and Cadillac 221.

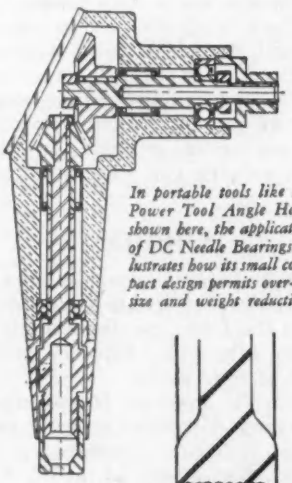
"Combined operations" (simultaneous production of war goods and automobiles) undoubtedly will be carried on until the end of the war with Japan, Wilson stated. After that time, he predicted, the corporation will build up to 2,750,000 of the 6 million cars the auto industry is expected to build annually.

It was stated at the meeting that G.M. has no present plans to build a "jeep" type car. At the outset of production a limited number of body styles

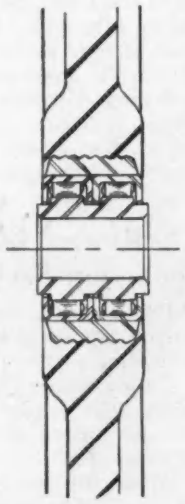
To Reduce Weight Use Needle Bearings



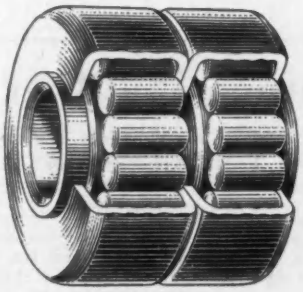
TYPE DC



In portable tools like the Power Tool Angle Head shown here, the application of DC Needle Bearings illustrates how its small compact design permits over-all size and weight reduction.



Full advantages of anti-friction operation with resultant weight savings in aircraft pulleys is obtained through Needle Bearings. X-section shows the double row PN Type.



TYPE PN (Double Row)

HIGH CAPACITY IN SMALL SPACE MAKES LIGHT WEIGHT NEEDLE BEARINGS IDEAL ANTI-FRICTION UNITS FOR MANY APPLICATIONS

•

In applications where weight and space are at a premium, the use of Needle Bearings has been widely adopted as the ideal solution to many design problems. For the Needle Bearing's full complement of small diameter rollers held within a compact retaining raceway provides a unit which is extremely *light* in relation to its high load capacity. Furthermore, the small over-all size of the Needle Bearing enables the design engineer to reduce size and weight of the bearing housing and frequently of other component parts as well—without sacrifice of strength, efficiency, or performance.

Ample testimony to the weight saving as well as other important features of Torrington Needle Bearings is found in the widespread use of many types in the aircraft industry. For example, in a single fighter plane, the Republic P-47 Thunderbolt, there are 53 applications of Torrington Needle Bearings all contributing weight reduction *and* improved performance!

Expressed another way—in a laminated plastic aircraft pulley equipped with the double row PN Type Needle Bearing there is weight saving which represents a net increase in the pay load.

In applications in other fields weight savings may be translated into greater operating efficiency and economy, increased sales appeal, or savings in packing and shipping costs.

In your own work toward the elimination of excess or unnecessary weight, investigate the advantages offered by Torrington Needle Bearings. The possibilities offered may surprise you. Our engineering department will gladly render every assistance in laying out applications to secure the full advantages of Needle Bearings in any design job. Or if you wish more preliminary information write for a copy of the Torrington Needle Bearing Catalog No. 30A.

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NEEDLE BEARINGS

will be built, with additional models being added when production facilities permit. Prices are expected to be higher than prewar levels, and a lift of 20 per cent paralleling the wartime boost in truck prices because of high labor costs was seen as a reasonable guess.

General Motors is planning to spend $500 million in the postwar period to reconvert and to expand its production facilities. A general estimate is that it will take approximately $75 million for reconversion, leaving $425 million for new buildings, machinery, and equipment.

Business in Brief

***Written by the Guaranty Trust Co., New York, Exclusively for* AUTOMOTIVE AND AVIATION INDUSTRIES**

General business activity remains fairly stable. The seasonally adjusted index of *The New York Times* for the week ended Sept. 2 stands at 140.9, as compared with 142.3 for the preceding week and 140.8 a year ago.

Department store sales, as reported by the Federal Reserve Board, declined from 179 to 161 per cent of the 1935-39 average in the week ended Sept. 9; but the indicated value was 14 per cent above the corresponding sum in 1943. For 1944 to date, the total is 8 per cent greater than the comparable amount last year.

Railway freight loadings during the week ended Sept. 2 totaled 898,450 cars, 0.8 per cent less than the preceding weekly number and 0.3 per cent below the corresponding figure in 1943.

Production of electric power in the week ended Sept. 9 was further reduced, to a level slightly below that of a year ago. The output during the preceding week was 1.5 per cent above the comparable amount in 1943.

Crude oil production during the week ended Sept. 9 averaged 4,689,400 barrels daily, an all-time peak, 31,750 barrels above the figure for the week before but 66,600 barrels less than the average output in September recommended by the Petroleum Administration for War.

Estimated production of soft coal during the week ended Sept. 2 was 11,575,000 net tons, 4.1 per cent less than the preceding weekly figure. For 1944 to date, the indicated output is 7 per cent above the comparable amount in 1943.

Engineering construction contracts awarded during the week ended Sept. 14 totaled $42,470,000 according to *Engineering News-Record*. This amount is 66 per cent above that shown for the preceding holiday-shortened week but slightly less than the corresponding sum in 1943.

The Irving Fisher index of wholesale commodity prices, advanced one fractional point in the week ended Sept. 8 to a new high level, 113.3 per cent of the 1926 average, as against 110.8 a year ago.

Member bank reserves increased $305,000,000 during the week ended Sept. 13, and excess reserves rose $200,000,000, to an estimated total of $1,000,000,000. Business loans of reporting members increased $2,000,000 in the preceding week and stood $221,000,000 above the total a year ago.

Ford Willing to Raise Workers' Wages

Henry Ford has announced that he is ready and willing to raise wages of all Ford workers numbering approximately 160,000, as soon as the government will permit him to do so. Although he gave no hint of the extent of the raise, it was acknowledged that it would depend on the lifting of government restrictions and the stabilization of the economic conditions. The average wage in the larger Ford plants at present is $1.25 per hr.

If such a move were made it would mark the third time in 40 years that the Ford Motor Co. raised wakes above the standard of the country. In 1914 when the prevailing average wage was about $2 per day, Ford instituted the $5 a day minimum scale. In 1929 the minimum daily pay was raised to $7.

Obituary

Dwight L. Armstrong, 50, vice-president of the Armstrong Cork Company, died in the Lancaster General Hospital, Sunday afternoon, Sept. 10, after an illness of four weeks.

Philip G. Johnson, 50, president of the Boeing Airplane Company and the Boeing Aircraft Company, died at Wichita, Kan., Sept. 14, at St. Francis Hospital, as the result of a stroke.

U. S. Rubber Enlarges Production Facilities

WPB has approved an expansion program approximating $5½ million for building and equipping facilities at the United States Rubber Co. plant at Detroit. The project is intended to increase production of high flotation tires and tubes for the military, probably indicating anticipated stepped-up amphibious landing operations, since high flotation tires are used on Army "ducks."

Plans call for building construction costing $3,015,775 and including a three story addition, 86 by 165 ft, and a four story addition, with basement, 174 by 180 ft.

ACWP Receives Special Honorable Mention

The Automotive Council for War Production has been awarded one of eight special honorable mentions given by the American Trade Associations' Executives for cooperative services to business men by trade associations.

The council's award was won on the basis of its contribution to the successful prosecution of the war through removing peacetime barriers to industry-wide teamwork without impairing the individual freedom and responsibility essential to maximum production. Also considered were the Council's services in the interchange of information on production methods, compiling and indexing information on available tools for sale or lease, reporting available capacity for manufacturer of machining accessories, gathering information on manpower problems, and keeping war contractors informed on government policies, rules, and regulations.

The Council represents more than 500 member automotive companies.

Packard Acquires Additional Space

In the first step to free more than a million square feet of floor space in its main factory for speedy reconversion to car output, Packard Motor Car Co. has purchased outright the Bundy Tubing Company's Hern Avenue plant in Detroit containing approximately 110,000 sq ft of space, according to George T. Christopher, president.

In line with the company's recently announced policy of acquiring additional space in which to carry on its war work, Packard will move its machining operations on Rolls-Royce aircraft engine crankcases to the new plant "machine by machine, operation by operation," to prevent any interruption in production of engines. The transfer will entail shifting of an estimated 1200 employees and movement of 130 heavy and hand-operated machines. The new plant, located 2¼ miles east of the main factory, will operate two shifts of 10 hr each. Layout for the new plant, which will be operated as a division of the main factory, already has been completed and production is scheduled to begin within 60 days. H. A. Garvey, associated with Packard for 32 years as production executive, will be plant manager. The deal for the factory was made with Packard's own funds exclusively.

Chrysler Creates Seven New Sales Divisions

Creation by Chrysler Div. of Chrysler Corp. of seven new sales regions increases to 28 the number of regions now set up in the United States in preparation for new car sales.

Managers of the new regions and their locations are: John F. Zeder, Jacksonville, Fla.; Ralph L. Weber, Pittsburgh; A. A. Engstrom, Milwaukee; Frank P. McGrath, Bismarck, N. D., and V. N. Alderman, Salt Lake City. Managers for the New Orleans and El Paso regions will be announced later.

Regional manager for the Philadelphia district is Harold F. Keegan, who held the post before the war. Porter T. White, acting manager at Philadelphia, will succeed M. T. Kale as head of the Seattle, Wash., district. Kale will become factory representative of the district.

ADVERTISEMENT

The CONE AUTOMATIC MACHINE COMPANY sees many GOOD THINGS AHEAD

It is reported that . . . . . .

A recently patented heating plate has two elements from which four degrees of heat may be obtained by using them singly or in combination as well as in series or parallel.

get ready with CONE for tomorrow

A new patent covers the use of perforated plates at the bow of a small, fast motorboat which permits the hull to ride on a cushion of foam.

get ready with CONE for tomorrow

Spraying the interior of a freight car or truck with dry ice is being tried as an inexpensive method of refrigeration.

get ready with CONE for tomorrow

Serious consideration is being given to the making of illuminating gas near the coal mines and its delivery by pipe line.

get ready with CONE for tomorrow

Cigarette paper, formerly a French monopoly, is now being successfully made in this country.

get ready with CONE for tomorrow

A capsule has been developed that is said to be effective in the prevention of seasickness in about 75% of the cases tested.

get ready with CONE for tomorrow

Cloth is being made from shredded redwood bark mixed with wool.

get ready with CONE for tomorrow

Experiments are being made to determine the suitability of animal blood for human transfusion.

get ready with CONE for tomorrow

Shafts for generators are now being squeezed into shape with dies.

get ready with CONE for tomorrow

A new plant processes 25,000 pounds of milkweed floss per day.

Shoal draft boats with tunnel sterns are made more efficient by the use of a small stand-pipe over the propeller which is kept full of water by a vacuum pump. The propeller is thus constantly surrounded by water although above the water level.

get ready with CONE for tomorrow

Anthropology is not popularly thought of as a commercially useful science, but anthropologists were consulted in designing seats for aircraft, gas masks, and goggles, and they might well be turned loose on the problems of private and public furniture after the war.

get ready with CONE for tomorrow

Airplane propellers are now being made of sponge rubber over a metal core.

Apparatus now in use by our army is expected to make it possible for civilians to forecast weather accurately as much as 24 hours ahead.

get ready with CONE for tomorrow

One of the country's largest chemical companies states that 46% of its gross sales for last year consisted of products unheard of fifteen years ago.

get ready with CONE for tomorrow

Rayon is being used for tire cord, parachutes, paint brushes, pump packing, bullet-proof gas tanks, lint-free gloves, electrical insulation, gas-proof clothing, cartridge bags, felt, and rugs.

get ready with CONE for tomorrow

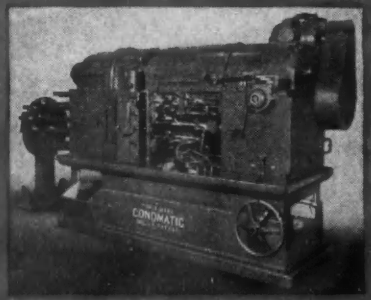
Optimistic producers of synthetic rubber say that, in the future, people will buy new automobiles to go with their old tires.

get ready with CONE for tomorrow

Ball bearings are now being made small enough to replace the jewels used in many precision instruments.

Tomorrow's production should eliminate second operations

The 8-Spindle Conomatic produces these wheel hub bolts from SAE 1030 in 34 seconds each. Slot milling in the large diameter and stamping the letter on the end are done without stopping the spindle. Conomatics reduce costs, save time, and eliminate second operations.



CONE

AUTOMATIC MACHINE CO., INC. ★ WINDSOR, VERMONT, U. S. A.

10

PUBLICATIONS

The Use and Care of Micrometers is the title of a new 24-page illustrated booklet published by Sav-Way Industries. Designed to introduce Sav-Way master setting and checking rolls for micrometers and other precision measuring instruments, the booklet dissects the micrometer, explains in detail the functions of various parts, tells how to use it and how to take care of it. Included is a valuable **do and don't** list aimed at prolonging the life and serviceability of the instrument.*

To emphasize the importance of **correct** spring design, the Muehlhausen Spring Corp. has published a new 8-page booklet, **Springs Designed For the Job Improve Product Performance.** The two-color booklet describes the factors essential to designing a spring for an application correctly. The basic types of springs are illustrated and defined and a wide variety of many shapes and sizes into which these types may be designed are shown.*

The Cleveland Worm and Gear Co. has issued a 4-page illustrated bulletin descriptive of the new **Speedaire Fan Cooled Work Gear Reduction Units.** A large illustration in the center spread of this bulletin shows how the high velocity air stream is held on a directed course by the double wall housing, how the heat-dissipating surface is nearly doubled by integrally cast fins on the outer wall of the housing.*

Chain Belt Co has produced a new folder descriptive of **REX Flat Spray Nozzles.** Besides illustrating and describing the nozzle uses, the folder gives tabular information concerning their discharge in gallons per minute; dimensions; a list of materials, sizes and prices.*

The technical aspects of the **Profilometer** as an electronic measuring instrument are discussed in a new Technical Supplement issued by Physicists Research Co. The new booklet is a complete revision and enlargement of Profilometer Comments and is devoted mainly to the development and technical side of the Profilometer. A section of the book describes the entire line of equipment.*

A new bulletin on type **6NAO Palnut** has been issued by The Palnut Co. It illustrates the new type Palnut, designed for use either as an adjustment nut or as a self-locking nut for light weight assemblies. It explains the design, enumerates its advantages, lists sizes and dimensions, illustrates typical applications, has a graph showing load carrying capacities and tells how to order.*

U. S. Tool & Mfg. Co. has announced the publication of a 4-page insert for their 60-page tool catalog that describes two new models of **radius dressers.***

An 8-page illustrated booklet, **4 Ways to Give Your Engine A Lift,** has been issued by the Amalie Div., L. Sonneborn Sons, Inc. It discusses engine difficulties that may be encountered when corrosion, clogging and gum formations attack carburetors, tanks, combustion chambers and valves.*

A new pamphlet, entitled **Cut Costs With Haynes Stellite Hard-Facing Rods,** is available from Haynes Stellite Co., a unit of Union Carbide and Carbon Corp. The pamphlet explains the advantages of protecting wearing parts by hard-facing with Haynes Stellite Alloy, lists typical parts that can be hard-faced in various industries and illustrates some of these parts.*

Marquette Engraving & Mfg. Co. has issued a 4-page bulletin describing its line of **marking devices.** The bulletin describes and illustrates die inserts, roller dies, special type and type holders, a special holder for embossing type, steel stamps, steel letters and figures. A size chart is included to aid in selecting correct size symbols.*

A new bulletin, **Bursting Pressures of Seamless Steel Tubing,** has been issued by Globe Steel Tubes Co. Designed as a reference chart for engineers, the bulletin contains tables of bursting pressures of seamless steel tubing from ⅛ in. to 9⅝ in. O.D.*

Moreland Tool Co. has issued a 20-page catalog that illustrates and includes specifications of a new **counterbore and special high speed steel cutting tool.***

* Obtainable by subscribers within the United States through Editorial Dept., AUTOMOTIVE *and* AVIATION INDUSTRIES. In making requests for any of these publications, be sure to give date of the issue in which the announcement appeared your name and address, company connection and title.

★ "E" Star Awards ★

for continuous meritorious services on the production front have been awarded to the following firms:

ALLEGHENY LUDLUM STEEL CORP., Pittsburgh, Pa.
BOUND BROOK OIL-LESS BEARING CO., Bound Brook, N. J.
J. G. BRILL COMPANY, Philadelphia, Pa.

CALENDAR

Conventions and Meetings

SAE Natl. Aircraft Eng. & Production Mtg., Los Angeles — Oct. 5-7
American Society of Tool Engineers, Syracuse, N. Y. — Oct. 12-14
American Welding Soc., Annual Meeting, Cleveland — Oct. 16-19
American Society for Metals, Cleveland — Oct. 16-20
Natl. Machine Tool Builders Assoc., Annual Meeting, Hot Springs, Va. — Oct. 19-20
Inst. of Aeronautical Sciences, Natl. Air Transport Meeting, Washington — Oct. 20
Distribution Conf., Chamber of Commerce of the U. S., New York — Oct 23-24
Natl. Lubricating Grease Institute, Annual Meeting, Chicago — Oct. 23-25
SAE Natl. Fuels & Lubricants Mtg., Tulsa — Nov. 9-10
Natl. Standard Parts Assoc., Annual Fall Conference, Chicago — Nov. 9-11
American Chemical Society Natl. Chemical Exp., Chicago — Nov. 15-19
SAE Natl. Air Cargo Mtg., Chicago — Dec. 4-6
Natl. Aviation Trades Assoc., St. Louis — Dec. 6-7-8
SAE Annual Meeting, Detroit — Jan. 8-12
Automotive Electric Assoc., Chicago — Feb. 5-12

PERSONALS

Reo Motors, Inc., has announced the appointment of **K. W. Wright** as branch manager of the newly opened direct factory branch at Manchester, N. H.

Donald W. Douglas, President of Douglas Aircraft Co., was elected president of the National Aircraft War Production Council. **Alfred Marchev,** president of Republic Aviation Corp., was elected vice-president.

E. I. duPont deNemours & Co., Inc., has announced the following personnel changes in its organization: **Warren A. Beh,** assistant sales director of the Nylon Div., has been promoted to director of nylon sales. **George S. Demme** is to be Mr. Beh's assistant. The retirement of **William Richter** as general manager of the Fabrics and Finishes Dept. and the appointment of **J. Warren Kinsman** as his successor, have been announced. **H. L. Benner** has been appointed Detroit technical representative of the Electroplating Div. **Emilie F. duPont,** now Nylon Div. production director, becomes assistant manager of the Acetate Div. **Robert A. Ramsdell** has been appointed assistant manager of the Nylon Div. and **Dr. G. W. Filson** has been named assistant manager of the Rayon Div.

National Carbon Co. has announced the following appointments to handle the sales of company products under a new sales arrangement. **F. W. Berdan** will manage the New York Div., **J. A. Hammond** the Pittsburgh Div. and **H. A. Stewart** the Chicago Division.

The Torrington Co., Bantam Bearings Div., has announced the appointment of **Harold C. Olson** as sales manager and **John A. Toth** as assistant sales manager.

E. J. Lyons has been appointed director of industrial relations for the Curtiss-Wright Corp. Airplane Div. Prior to his appointment he was assistant to the general manager of the Airplane Div.'s Columbus, Ohio, plant.

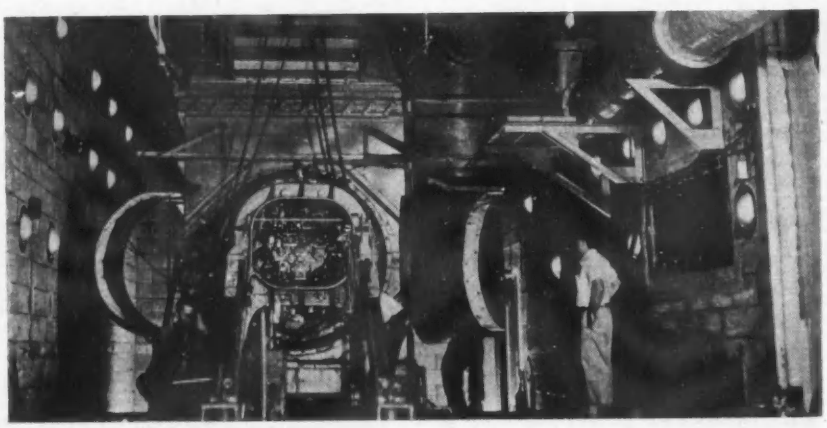
Inland Steel Co. has announced the appointment of **Leon C. Reed** as assistant manager, Railroad Sales Div. and **Kenneth J. Burns** as Chicago district sales manager.

Walter Bowers has been appointed vice-president and treasurer of the Lawrence Aeronautical Corp.

John J. Couch, formerly vice-president, G. S. Rogers & Co., has been elected president to fill the vacancy created by the death of George S. Rogers on July 6th. **E. L. Milford** has been elected vice-president, **David H. Henry,** vice-president and secretary and **Royce R. Baker,** treasurer.

W. R. Persons, Pittsburgh district man-

$500,000 Aviation Fuel Test Unit



Designed for research on aviation fuels and lubricants, the test unit opened in September at Bayway, N. J., by the Standard Oil Co. (New Jersey) was built at a cost of $500,000. In this photo is shown the interior of the test cell, which is equipped for test work with aviation engines of air cooled or liquid cooled types. Engines beyond 2500 hp can be tested under simulated flight conditions.

LODGE & SHIPLEY LATHES *at work*

turning Cylinder Liners, Sprocket Shafts, Track Roller Hubs, Transmission Shafts, Gear Blanks and Shafts.

AT CATERPILLAR TRACTOR CO.

Throughout "Caterpillar's" giant factory, Lodge & Shipley Duomatic Lathes demonstrate their unmatched versatility, turning endless quantities of highly varied components for Diesel Tractors, Motor Graders, Engines and Electric Sets.

A *full automatic* lathe, the Duomatic is equally adaptable to large or small lots. Movements and set-ups are entirely mechanical; no cams are required to change cycles.

The dual carriages and tool slides -- front and rear -- are easily swiveled to cut from any angle. As a result, multiple tools can be used to far greater advantage than ever before in turning and in straight and angular facing operations.

In shops of every type, Duomatics continually prove their amazing efficiency. Call Lodge & Shipley Engineers for full details on these cost-cutting, labor-saving lathes. Or write on your company letterhead for Bulletin No. 601, showing standard cycles and other helpful data.

ENGINE
TOOL ROOM
AUTOMATIC
OIL COUNTRY LATHES

THE LODGE & SHIPLEY MACHINE TOOL CO.

CINCINNATI 25, OHIO, U. S. A.

L & S LATHES

ager of The Lincoln Electric Co., has been transferred to the factory and main office at Cleveland to carry out a special postwar planning asignment.

John J. Dunn has been appointed truck distribution manager for the Dodge Div. of Chrysler Corp.

Roy T. Hurley has been elected vice-president of Bendix Aviation Corp. and has been assigned the special problem with which the corporation is confronted in the reconversion and immediate postwar period.

Arthur Nutt, vice-president of enginering, has resigned from Wright Aeronautical Corp., Paterson, N. J.

John B. Girdler, sales representative for the past four years, has been appointed sales manager, Eastern District of the Vanadium Corp. of America, with headquarters in New York City.

Tru-Test has announced the appointment of **Samuel D. Kennedy** as manager and director of their automotive accessories division. He will make his headquarters at Oakes & Company's Chicago office.

Russell H. Lasche has been appointed director of engineering and research for the Fairchild Camera & Instrument Corp.

Western Insulated Wire, Inc., has announced that **Edgar H. Hammond, Jr.,** has joined their company as manager of sales and field engineering.

James P. Roberts, assistant manager of the Chicago Branch of the Ford Motor Co. for the past four years, has been appointed manager of the St. Louis, Mo., branch. **C. M. Pfeiffer** will retain his post as assistant manager at St. Louis.

Arthur C. Seligren, zone manager at Cleveland for Buick Div. of General Motors for the past six years, has been appointed zone manager in Detroit.

Bendix Aviation Corp. announces the appointment of **David J. Bonawit,** formerly executive engineer of the Manhattan division of Raybestos-Manhattan Corp., as chief engineer of the Marshall-Eclipse division.

Curtis W. Keegin, associated with the automotive manufacturing industry in Detroit for the past 18 years, has been appointed sales manager of the Pump Div. of Monroe Auto Equipment Co.

Cleveland Pneumatic Tool Co. Marks 50th Anniversary This Year

Marking its fiftieth anniversary this year, The Cleveland Pneumatic Tool Co., Cleveland, Ohio, is busily engaged in the manufacture of aircraft landing year, pneumatic tools, rock drills, shock absorbers and other equipment for military uses. Its Cleveland Pneumatic Aerol, Inc., division, producing "aerol" air-oil shock struts, covers about 16 acres of floor space and is claimed to be the largest factory in this country devoted exclusively to straight-line production of aircraft landing gear.

The shock absorbing unit manufactured by the Cleveland Pneumatic Tool Company, known as the Cle-Air, embodies the double-acting hydraulic principle combined with an air cushion for the compression stroke to produce a soft ride.

1944 Monthly Production of Trucks and Truck Tractors*

LIGHT
Under 9000 lb. GVW.

1944	Civilian	Military	Total
January	.....	21,479	21,479
February	.....	21,095	21,095
March	.....	21,081	21,081
April	.....	19,481	19,481
May	.....	19,338	19,338
June	.....	20,830	20,830
July	.....	20,269	20,269
Total—7 Months	.....	143,573	143,573

MEDIUM
9000 to 15,999 lb. GVW.

	Civilian	Military	Total
January	1,985	12,812	14,797
February	1,798	9,940	11,738
March	3,317	8,404	11,721
April	6,245	6,542	12,787
May	7,310	7,012	14,322
June	9,319	6,620	15,939
July	8,600	6,031	14,631
Total—7 Months	38,574	57,361	95,935

HEAVY
16,000 lb. and over GVW.

	Civilian	Military	Total
January	543	21,784	22,327
February	967	21,867	22,834
March	1,311	22,362	23,673
April	1,903	21,441	23,344
May	1,988	21,299	23,287
June	2,592	21,816	24,408
July	2,662	24,005	26,667
Total—7 Months	11,966	154,574	166,540

TOTAL—ALL WEIGHTS

	Civilian	Military	Total
January	2,528	56,075	58,603
February	2,765	52,902	55,667
March	4,628	51,847	56,475
April	8,148	47,464	55,612
May	9,298	47,649	56,947
June	11,911	49,266	61,177
July	11,262	50,305	61,567
Total—7 Months	50,540	355,508	406,048

*—Automotive Division—W.P.B.

Motor Truck and Truck Tractor Production —1936-1943*

LIGHT
Under 9000 lb. G.V.W.

	Civilian	Military	Total
1936	317,189	1,004	318,193
1937	396,326	368	396,694
1938	209,575	690	209,265
1939	306,098	1,651	307,749
1940	337,983	13,365	351,348
1941	367,467	72,164	439,631
1942	23,427	277,413	300,840
1943	0	268,438	268,438

MEDIUM
9000 to 15,999 lb. G.V.W.

	Civilian	Military	Total
1936	417,395	1,125	418,520
1937	437,525	1,266	438,791
1938	249,886	1,119	250,005
1939	343,190	2,900	346,090
1940	323,088	36,042	359,130
1941	408,367	128,170	536,537
1942	86,072	169,188	255,260
1943	179	154,808	154,987

HEAVY
16,000 lb. and over G.V.W.

	Civilian	Military	Total
1936	36,045	596	36,641
1937	38,267	69	38,336
1938	20,846	439	21,285
1939	36,008	1,637	37,645
1940	39,030	5,982	45,012
1941	47,371	18,323	65,694
1942	15,795	225,032	240,827
1943	2,709	249,368	252,077

TOTAL—ALL WEIGHTS

	Civilian	Military	Total
1936	770,629	2,725	773,354
1937	872,118	1,703	873,821
1938	478,307	2,248	480,555
1939	685,296	6,188	691,484
1940	700,101	55,389	755,490
1941	823,205	218,657	1,041,862
1942	125,294	671,633	796,927
1943	2,888	672,614	675,502

*—Automotive Division—W.P.B.

Large Scale Production of Helicopters

(*Continued from page* 44)

ed by the smaller rotor mounted on the tail to counteract the torque of the main blades. The machine has fuel capacity for five hours flight and carries high frequency radio.

The R-6 has a normal gross weight of 2600 lb. The pilot's cabin, which is heated and soundproof, is at the forward section of the fuselage and is all metal except for the cabin section supports made of plastic impregnated glass fiber cloth moulded and mounted on the aluminum floor. The plexiglass nose and panels surrounding the pilot's cabin provide "goldfish bowl" visibility. Landing gear is conventional construction, with a small tail wheel between nose and tail and a forward wheel to prevent nosing over.

Subassemblies are being made at the Nash-Kelvinator plant at Grand Rapids and are shipped to the Detroit plant for assembly on a mass production basis. It is expected that the R-6 will be used for evacuating wounded, carrying blood plasma, rescuing flyers shot down behind enemy lines, messenger service and dropping depth charges on submarines. It can take off and land vertically, fly forward, backward, and sidewise, or hover in mid-air.

Because of its newness, the helicopter field still is a matter for study. Although efficient, the behavior of rotor blades in flight presents a number of problems of balance. To arrive at a better standard of performance, Nash engineers in conjunction with the Air Technical Service Command have constructed a new type test building to determine why some blade installations perform better than others.

Factors Back of Demand for L.S. Formula Revision

(*Continued from page* 44)

minority, was over retention of the no-strike pledge. After rejecting previous resolution, calling for: 1, retention of the pledge; 2, outright revocation, and 3, retention in war plants and revocation in plants reconverted to civilian production, the delegates finally voted two-to-one to retain the pledge unequivocally, subject to a referendum of the membership at large to be held within 90 days.

After beating down a proposal calling for creation of a third vice-presidency, the delegates re-elected all incumbent officers. They include R. J. Thomas, president; Walter P. Reuther and Richard T. Frankensteen, vice-presidents, and George F. Addes, secretary-treasurer. A financial report shows the union to be big business. Income for the last 11 months amounted to more than $6,250,000 and assets stand at more than $2½ million.

FOR CONTROLLED FLOW OF FUEL OIL
this oil burner nozzle must be held to an exact tolerance. Because Carpenter Stainless No. 5 was supplied uniform, shipment after shipment, it consistently produced more perfect parts than could be obtained from other metals. With the reduction of rejects and increased tool life, costs were substantially reduced.
GOOD FINISH AND CLEAN THREADS
on these valve parts are clearly evident. Again the uniform easy-working qualities of Carpenter Free-Machining Stainless No. 5 helped the valve manufacturer turn out more perfect parts at a minimum cost.

REDUCE YOUR COSTS

In Machining Stainless Parts

The oil burner nozzle part illustrated above is just one example of the way Carpenter Free-Machining Stainless Steels help to reduce unit costs in machining Stainless parts. Tool breakage was running excessively high on this job—as were rejects due to the fact that close tolerances, such as on the nozzle hole, could not be held uniform. As soon as Carpenter Free-Machining Stainless No. 5 went on the job improved results were immediately evident. The uniform quality of this Stainless grade licked production headaches and brought costs quickly in line.

Carpenter skills and ingenuity in manufacturing Stainless Steels date back to the early days when we helped pioneer these steels and invented the Free-Machining grades. We have made it our business to know all about these versatile metals and how they can best serve the needs of Stainless users. Out of this experience has come improved laboratory and inspection controls that assure consistent uniformity in physical characteristics and easiest fabricating qualities for all Stainless grades.

Your nearby Carpenter representative is ready to help you in planning your new or redesigned products. Call him in now, or write us at the mill for a copy of our 98-page book, "Working Data for Carpenter Stainless Steels."

The Carpenter Steel Company, 103 W. Bern Street, Reading, Pa.

Carpenter STAINLESS STEELS

...for
Strength
Rigidity
Heat Resistance
Corrosion Resistance
Longer Product Life
Sales Appeal

BRANCHES AT
Chicago, Cleveland, Detroit, Hartford,
St. Louis, Indianapolis, New York, Philadelphia

Cadillac Concentrates Over 1500 Machines on Allison Engine Parts

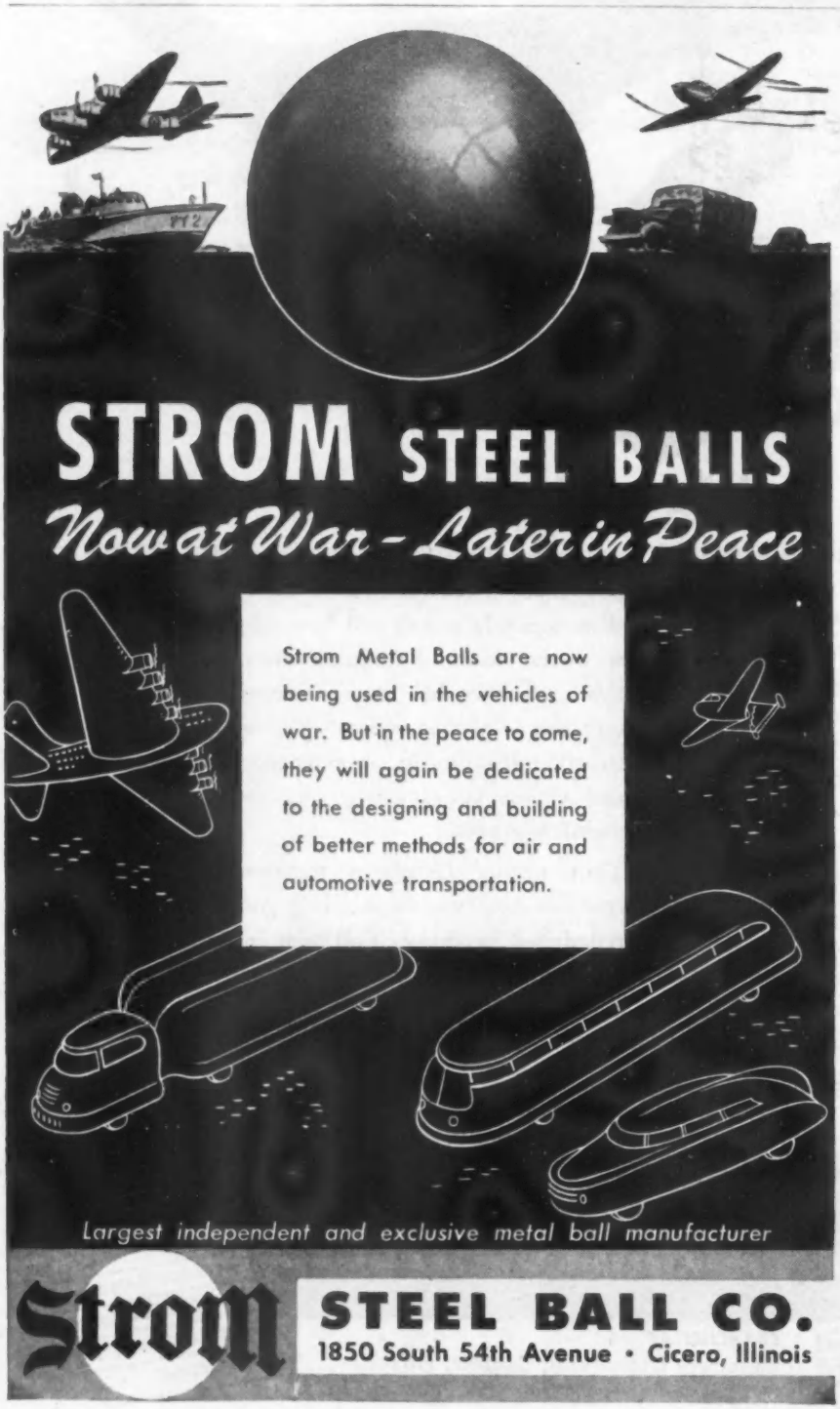
(*Continued from page* 30)

surface plate. The operator sets his inspecting instrument for a specific dimension using the master involved and compares this with the reading on the part being inspected.

Finally it may be observed that in the manufacture of precision aircraft parts the effectiveness of final results needs must be based upon a coordination of the manifold activities. The process begins with the establishment of raw materials specifications which must be controlled right at the producing mill. It follows through the forging procedure which, again, must be meticulously controlled. All of this takes place ahead of the machining cycle and must be absolutely right if the final product is to come out according to plan. In the machining stages there are the problems of work routing, with special attention to the normalizing of raw materials, of stress-relief following heavy metal removal; and, in general, a thorough coordination of metal cutting and metallurgical techniques.

Even a cursory inspection of the Cadillac Aircraft plant indicates that a great deal of attention has been given to the selection of equipment and to the development and design of specialized fixtures for a given job. Work-holding fixtures play a prominent role in precision machining. They are responsible for transferring skill from the operator to the machine; they are the deciding factor in maintaining high levels of quality.

Although it has been impossible in the brief space of a single article to touch upon the many outstanding operations found in this plant, we believe our readers will be able to visualize some of the activity from the pictorial views. These serve to point out the advanced types of equipment installed at Cadillac and, in many instances, show details of tooling and unique work-holding fixtures, in addition to emphasizing the ingenuity and "know how" of the organization.


STROM STEEL BALLS
Now at War - Later in Peace
Strom Metal Balls are now being used in the vehicles of war. But in the peace to come, they will again be dedicated to the designing and building of better methods for air and automotive transportation.
Largest independent and exclusive metal ball manufacturer
Strom
STEEL BALL CO.
1850 South 54th Avenue • Cicero, Illinois

National Metal Congress

(*Continued from page* 17)

American Welding Society:
- Welding and Cutting in Heavy Industries
- Railroad and Transportation
- Weldability
- Resistance Welding
- Research
- Structural
- Ships
- Aircraft
- Machinery
- Piping and Pressure Vessels
- Foundry
- Miscellaneous

AIME Institute of Metals Division:
- Magnesium
- Grain size of Magnesium
- Metals and Alloys
- Non-Ferrous Production Metallurgy
- General Session

AIME Iron and Steel Division:
- Dilatometric Analysis
- Symposium on Steel Making

Society for Experimental Stress Analysis:
- Fracture and Grain Size
- Rolling and Graphitization
- Symposium on Crankshaft Stresses
- Special Session on Electrical Strain Gage

American Industrial Radium and X-Ray Society:
- Experimental Stress Analysis in Radiographically Sound Materials
- Requirements in Specifications for Uniform Radiographic Technique
- X-Ray and Welding Control
- Method of Determining Metal Thickness Radiographically

A report on the Exposition, touching on developments of special interest to our readers in the automotive and aviation field, has been scheduled for the Nov. 1 issue of AUTOMOTIVE AND AVIATION INDUSTRIES.

Houdry discoveries helped the aircraft industry to set ahead the time table of aviation progress

Catalytic cracking, first developed and commercially pioneered by Houdry Laboratories, has influenced profoundly the advancement of aviation. Perfected by Houdry before the war, cat cracking provided the only means by which aviation fuel of higher quality might be produced in adequate quantity for any possible war requirements. Thus doubly assured, aeronautical engineers were enabled to develop, with no fear of fuel limitations, their most advanced designs; to bring closer, by many years, a new age of swift World Flight.

HOUDRY PROCESS CORPORATION, WILMINGTON, DEL.

Houdry Catalytic Processes and the T.C.C. Process are available through the following licensing agents to all American refiners, subject to approval by the United States Government.

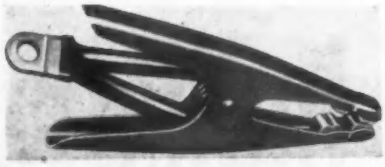
E. B. BADGER & SONS CO. Boston, Massachusetts • THE LUMMUS COMPANY New York City, New York • BECHTEL-McCONE CORP. Los Angeles, Calif.

HOUDRY CATALYTIC PROCESSES
FOR VICTORY IN WAR
FOR PROGRESS IN PEACE

New Production Equipment

(*Continued from page* 42)

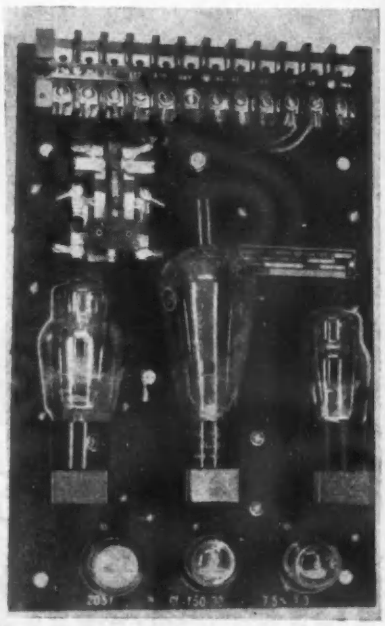
unit weighs 1½ lb., has a maximum jaw spread of 2½ in. and a rating of 300 amp.



Lincoln ground clamp

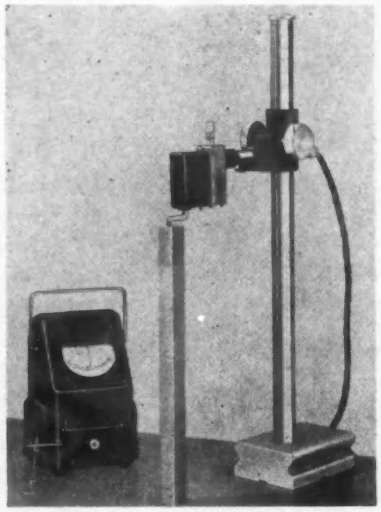
A PRECISE electronic forge-pressure timer has been incorporated in the line of capacity discharge controls of the General Electric Co., Schenectady, N. Y., for use with stored-energy type resistance welding machines. The new timer, which is designed for dual pressure spot welding machines of the capacitor discharge type, functions to supply accurately timed forge-pressure, so that the required welding energy, cracks, indentations, and sheet separation are reduced.

Calibrated in milliseconds, the timer consists of a timing circuit with a regulated d-c source of voltage to assure accurate timing; the necessary electronic tubes; and a time-delay relay with fixed timing for compensating for the delay in the operation of the solenoid valve on the welding machine, so that the forge-pressure can be applied precisely at any point during the current discharge.



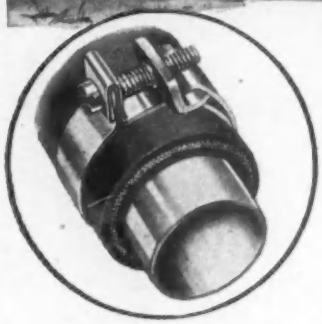
G-E discharge control for resistance welding machines

A NEW type of precision height indicator with Electrigage that gives a quick, positive and accurate reading is being offered by the Sheffield Corporation, Dayton, Ohio. It is designed for use on a surface plate and includes a surface plate block, a 26-in. column with rack, and a Sheffield Electrigage.



Sheffield height indicator

CENTRAL *UNIVERSAL* HOSE CLAMPS IN *Action!*



•Army and Navy combat vehicles, farm and road-building machinery, diesel and gasoline engines, and all types of radiator hose are equipped and serviced with Central Universal Hose Clamps.

THE *Half Track* DEPENDS ON CENTRAL CLAMP-POWER

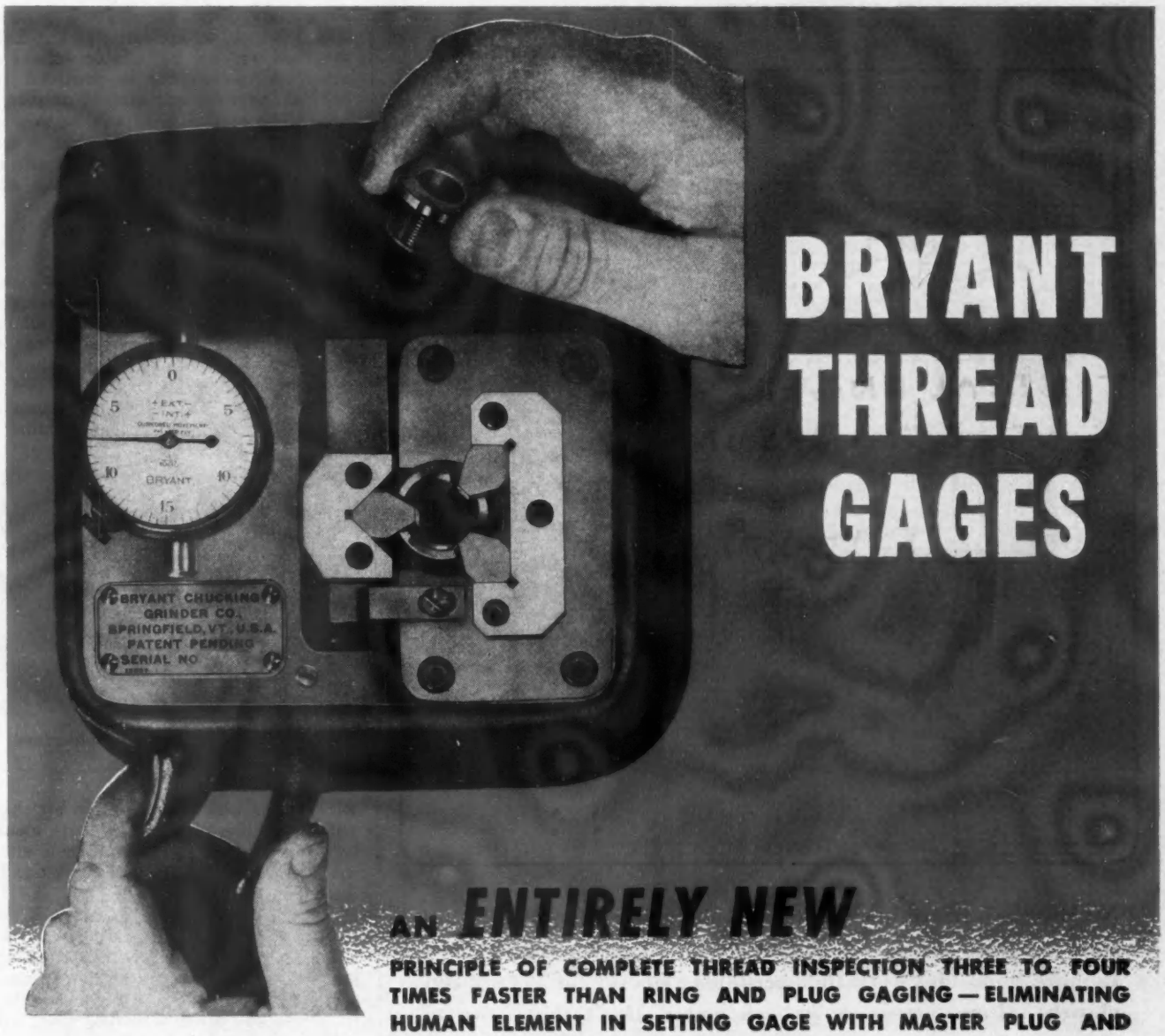
Central *Universal* Hose Clamps are supplying vital clamp-power with unfailing dependability to America's war machine.

They are strong enough for every production and service requirement . . . precision built of rustproof, extra-heavy cold rolled steel . . . self-locking . . . cannot strip or loosen . . . able to withstand abnormal pressure, stress, strain and vibration . . . easier to use in hard-to-get-at places . . . quickly attached or removed without disconnecting the line.

A single length *Universal* Clamp fits hundreds of diameter sizes.

SEND TODAY FOR FREE SAMPLE
When requesting sample please specify "Universal".

CENTRAL EQUIPMENT CO.
900 SO. WABASH AVE. CHICAGO 5, ILL.



BRYANT THREAD GAGES

AN *ENTIRELY NEW*

PRINCIPLE OF COMPLETE THREAD INSPECTION THREE TO FOUR TIMES FASTER THAN RING AND PLUG GAGING — ELIMINATING HUMAN ELEMENT IN SETTING GAGE WITH MASTER PLUG AND DURING INSPECTION OF WORK PART.

- ★ One unskilled operator replaces four or five skilled inspectors.
- ★ Gives complete over-all inspection in a few seconds.
- ★ Thread segments have many times the life of ring and plug gages.
- ★ Master gage accuracy transferred quickly to production parts.
- ★ Available in three standard models. (Special sizes on request.)

The NEW BRYANT THREAD GAGE checks the entire circumference of internal and external threads in a few seconds. The operator merely drops the part on the work rest, releases the control lever, and gives the work a *partial* turn only. The dial reading shows the accumulated inaccuracies in lead, taper, pitch diameter, thread form, and the presence of burrs or surface inaccuracies.

The Bryant Thread Gage makes it possible—*as never before*—to transfer the measurements of master thread gages accurately and quickly to the parts being produced—it eliminates tedious, slow, and expensive methods requiring skilled inspectors.

Write today for illustrated folder No. G2 which gives complete details.

BRYANT CHUCKING GRINDER COMPANY

SPRINGFIELD, VERMONT, U. S. A.

OUT OUR WAY

EVER SINCE WE STARTED USING SPEEDI-DRI TO SOAK UP OIL AROUND TH' BASES OF TH' MACHINES, OLD JUNO, THE SWEEPER, HAS HAD NOTHIN' TO DO BUT LEAN ON A BROOM!
THE BOSS IS EYEING HIM UP EVERY DAY-- PROBABLY FIGGERIN' ON MAKING A LATHE OPERATOR OUT O' HIM--GOOD IDEA, TOO!
T. M. REG. U. S. PAT. OFF. COPR. 1944 BY NEA SERVICE, INC.
THE MAN-POWER POOL
J.R WILLIAMS

NO SHOP can afford to support semi-idle man-power. SPEEDI-DRI works so fast and so easily that porter-labor can be diverted to more important work than scrubbing floors; for SPEEDI-DRI absorbs oil and grease *on its own power*. Don't shut down to clean up. Just spread SPEEDI-DRI on the floors and let it work while production goes on! At the same time, it will provide a non-skid surface that will stop costly slipping accidents; it will speed production by making workers more sure-footed; it will improve morale and increase efficiency.

SPEEDI-DRI is non-combustible and will not readily burn even when oil-soaked. It is recommended by leading insurance companies. No more economical method for cleaning floors was ever invented! Write for literature and FREE SAMPLE.

SUPPLIERS: East — Refiners Lubricating Co., New York 1, New York.
Midwest & South — Waverly Petroleum Products Co., Philadelphia 6, Pa.
West Coast — Waverly Petroleum Products Co., Russ Bldg., San Francisco 4, Calif.

SPEEDI-DRI
OIL AND GREASE ABSORBENT

1000-1 amplification, smallest graduation .0001 in., with electric pickup head mounted on an adjustable extension arm. A micrometer is provided for 3/32 in. vertical adjustment of pickup head. The pickup head can be rotated and locked in position within a full range of 360 deg., while a fine adjustment knob facilitates the coarse and fine setting-up.

AIRCRAFT - MARINE PRODUCTS INC., Harrisburg, Pa., is introducing a new hand tool which combines all the steps involved in preparing wire for solderless terminals and in crimping the terminals to the wire.

In addition to the usual crimping notches the 6-purpose tool includes a

Combination tool for solderless wiring

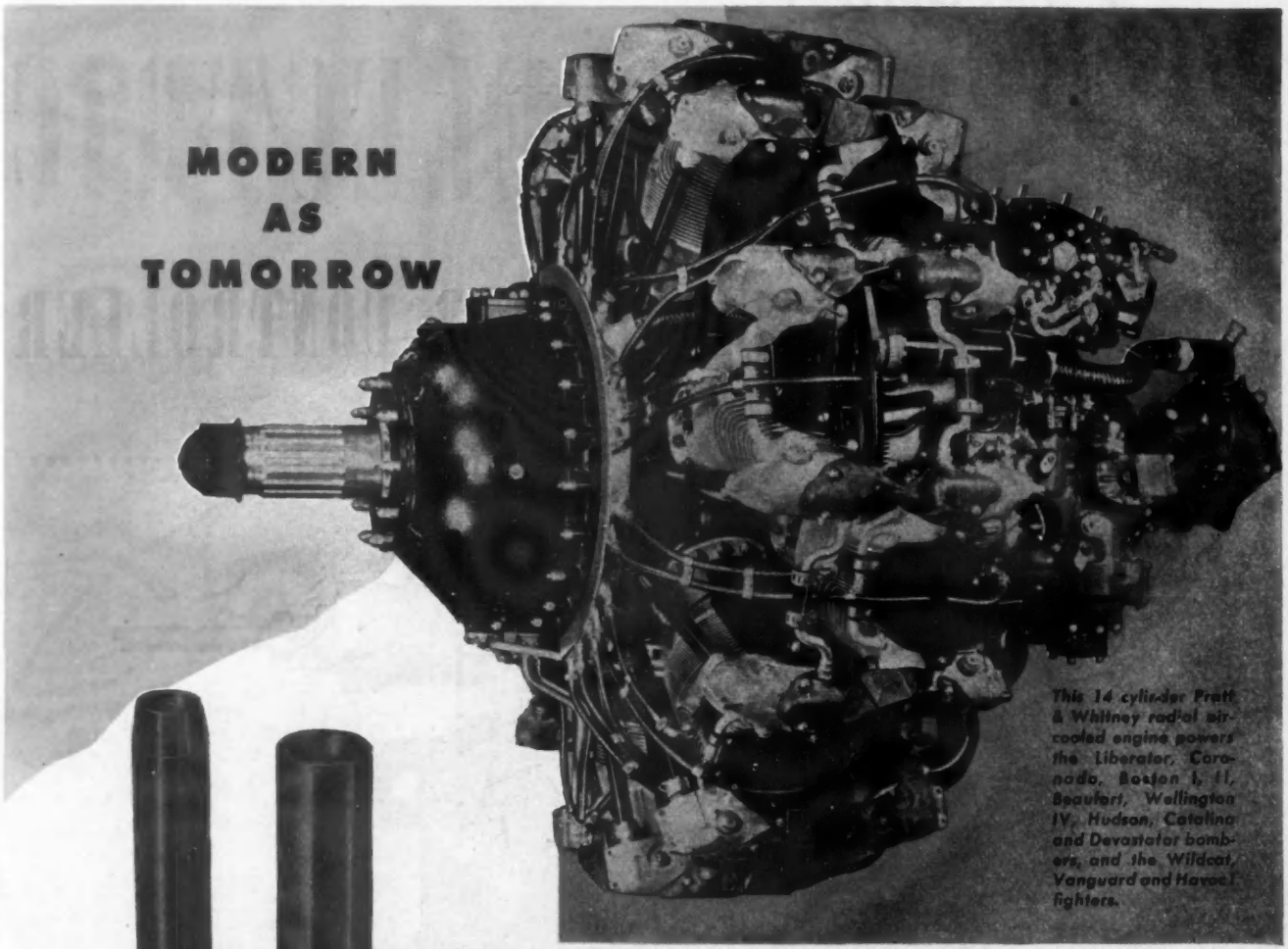
wire cutter and an insulation stripper with the correct stripping length clearly indicated. Terminal stud hole sizes are marked on the tool for quick checking.

Three types of AMP terminals, for wire sizes 22 to 10, are crimped by the tool—the AMP flag type, AMP standard (Type B), and the AMP one-piece terminal. Crimping notches are marked to correspond with terminals they will crimp and stripping notches are marked with Navy Shipboard and Commercial AWG wire sizes.

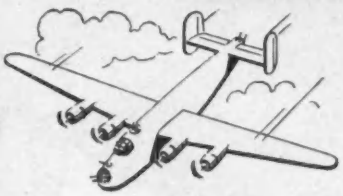
TO INCREASE the life of stressed parts such as gears, springs, axles, torsion bars, crankshafts, connecting rods, milling cutters, pneumatic drills, etc., by shot peening, a line of machines known as Wheelapeening equipment has been announced by American Foundry Equipment Co., Mishawaka, Ind.

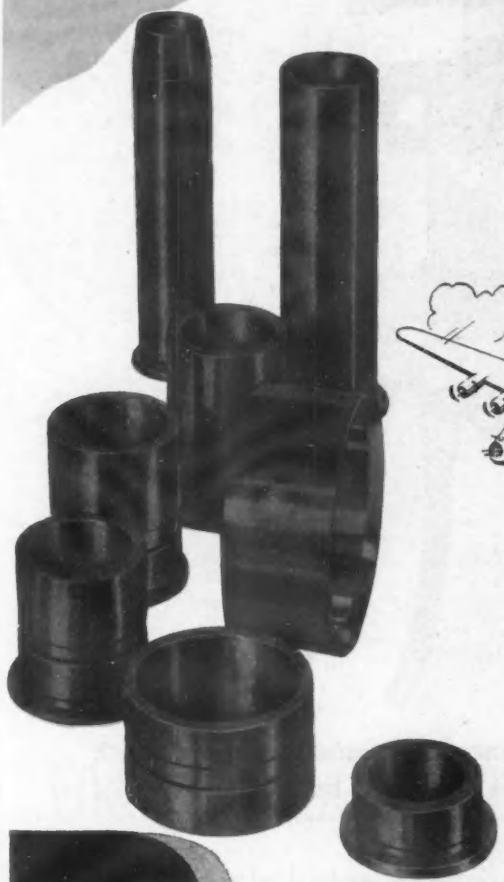
The Wheelabrator is a mechanical unit that utilizes controlled centrifugal force for throwing shot upon the work. It is completely airless. Shot is fed to the center of the bladed wheel from an overhead storage hopper whereupon it is hurled by centrifugal force upon the work to be peened. An impeller rotates with the wheel proper and carries the shot to an opening in the stationary control cage where it discharges to the bladed section of the wheel. At this point the shot is picked up by the inner ends of the throwing blades and is gradually accelerated in its passage to the periphery of the wheel.

MODERN AS TOMORROW



This 14 cylinder Pratt & Whitney radial air-cooled engine powers the Liberator, Coronado, Boston I, II, Beaufort, Wellington IV, Hudson, Catalina and Devastator bombers, and the Wildcat, Vanguard and Havoc fighters.





● In this engine, modern as tomorrow, a product of finest engineering and manufacture, there are sound reasons why sleeve bearings predominate.

Bunting Cast Bronze Bearings play an important part in this engine, as in many other machines of war. In the coming machines of peace, Bunting will play an equally important role.

Bunting Bronze Bearings, standard or special, and Factory Finished Tubular and Solid Bronze Bars promptly available. The Bunting Brass & Bronze Company, Toledo 9, Ohio. Warehouses in Principal Cities.

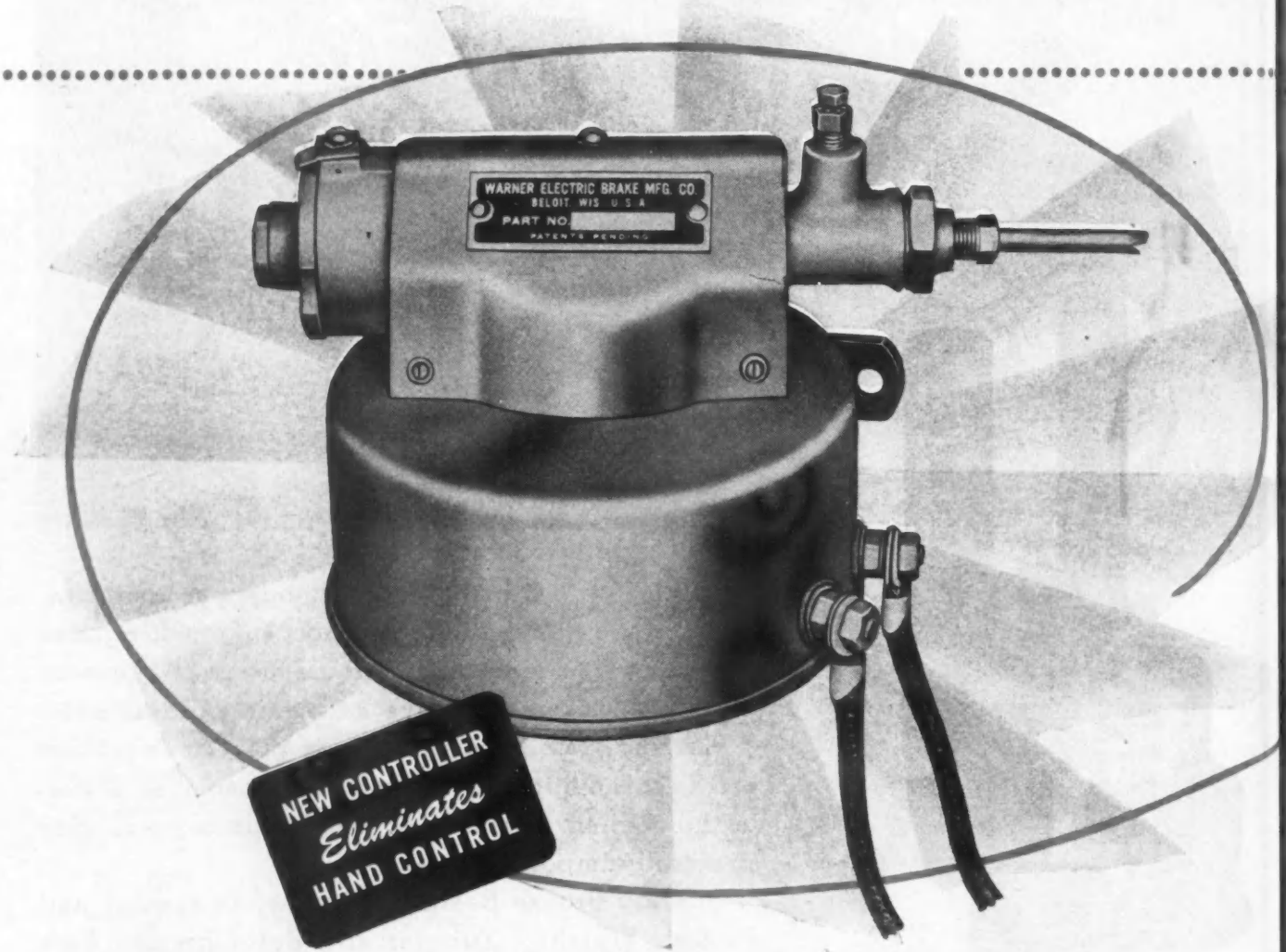
Bunting

BRONZE BUSHINGS ☆ BEARINGS ☆ PRECISION BRONZE BARS

Announcing

NEW WARNER ELECTRIC

Now INGENIOUS WARNER CONTROLLER



PERFECTED — *ready for delivery with Warner Electric Brake Systems* — or for quick change-over on tractor-trailers now equipped with hydraulic brake and Warner Electric Brake Combinations.

The new Warner Controller — simple and compact — synchronizes the hydraulic brakes on the tractor with the Electric Brakes on the trailer. The tractor's regular foot pedal operates both braking systems. This development creates smooth, foot-touch tractor-trailer braking under all conditions — eases driving strain — assures greater safety.

The new Warner Controller has the same basic simplicity of Warner Electric Brakes themselves — world famous for easy installation, and efficient, trouble-free performance. Get the benefits of this great advancement now. See your Warner dealer about changing over your present equipment. Specify Warner Electric Brakes on all future trailer purchases.

WARNER ELECTRIC BRAKE MANUFACTURING COMPANY · BELOIT, WISCONSIN

BRAKE ADVANCEMENT!

– *Synchronizes Tractor Hydraulic Brakes and Trailer Electric Brakes so Foot Pedal Operates them* TOGETHER

Controller is easily and quickly fitted into the hydraulic brake line.
Only a few flexible wires. Nothing to freeze or chatter . . . No complicated mechanisms.

FOOT PEDAL PRESSURE CONTROLS BRAKES ON *Both* TRACTOR AND TRAILER

WARNER
ELECTRIC BRAKES

Gyropilots at Auto-Lite

(*Continued from page* 40)

The electro-plating department is modern both in methods and equipment and designed to handle the plating of cadmium, copper, nickel, and zinc. In addition, there is a small unit for producing the Parker Lubrize coating on small hydraulic system pistons.

One large area of the plant is set aside for the "semi-subassembly" of the rotor and shaft. This department is equipped with a large battery of specially designed lapping machines for the lapping of shaft pivots.

The tiny ball bearings used in the instruments play such an important role that exceptional precautions are taken in processing them for use in the assembly department. Although these bearings are produced by their manufacturers to exacting standards of quality, each bearing is cleansed and inspected in every detail before it is accepted. This work is done in an air-conditioned room with white-tiled walls and white enameled work benches. The atmosphere is humidity-controlled to prevent rusting and is dust-free. To further assure cleanliness, all operators wear special lint-free uniforms and handle the work with kid gloves.

Bearings are rough-washed in an ante-room, then washed microscopically clean in the enclosed room. They are then inspected in every detail—for bore with the P & W Air-O-Limit gage, for the OD with the P & W Electro-limit gage. The bearings that pass this gauntlet are sealed in Pliofilm bags and are ready for assembly.

The final assembly department is a big glass-enclosed room, completely air-sealed and air-conditioned, to maintain standard conditions for dimensional sizing. Temperature and humidity are so controlled as to prevent atmospheric rusting. In addition, the enclosure is made dust-free by the use of the Precipriton which filters air electrostatically to remove the finest dust particles.

This department is divided into a number of major sections—one for the assembly of the directional control; another for the assembly of the bank-and-climb control; another for hydraulic units. In each case they have provided several rows of individual assembly benches for handling sub-assemblies and for final assembly. At the end of each line are the final tests for acceptance and calibration, the final test for gyro units being run on Scorsby machines.

Gyro rotors are dynamically balanced at extremely high rotative speed in specially designed machines, then run-in on a bench holding two banks of 20 rotors each.

Typical of self-contained process departments is the small paint department. This installation consists of a DeVilbiss spray booth with a closed-chain monorail conveyor on which the work is carried through an infra-red lamp oven for baking. A variety of non-ferrous housings and small parts are processed here.

Needless to say, instrument manufacture of this character is confronted with endless problems in production details and imposes a responsibility for constant improvement both in design and production technique. To this end, Auto-Lite has established a well-equipped laboratory adjacent to the engineering department. Here is found special apparatus for the life-testing of various parts of the mechanism, special instrumentation for calibrating diaphragms and other parts, and Sorsby testing machines for observing the behavior of finished instruments for long periods. The laboratory is used not only for research but for trouble-shooting as well, leading to the solution of problems of machining or assembly or calibration as they develop in the plant or in the field.

The knowledge, facilities and experience acquired over 72 years of manufacturing screw machine and cold upset products are applied by our highly skilled manpower to assure the highest quality and precision.

We are versatile enough to handle any of your screw machine problems, including all secondary operations, regardless of size, shape or form, and in unlimited quantities... If your parts require simple or complicated screw machine operations, try "Chicago Screw"—you'll find there is a difference. Our complete facilities and long experience provide the means and ability to meet your most rigid specifications.

ARMY E NAVY

THE CHICAGO SCREW CO.

ESTABLISHED 1872

1026 So. Homan Avenue Chicago 24, Ill.

HOW CONSOLIDATED VULTEE USES "LUCITE"

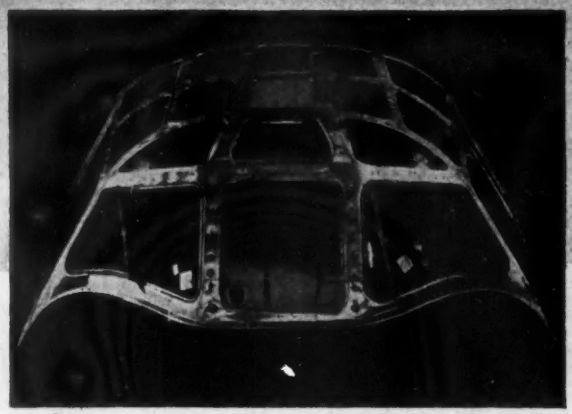
Crew of B-24 Liberator Bombers enjoy clear vision through enclosures of Du Pont methyl methacrylate resin sheeting

HERE IS another plane builder who—like Curtiss-Wright, North American, Martin, Douglas, Boeing and other leading aircraft manufacturers—uses Du Pont "Lucite" to provide excellent vision for pilot and crew.

Of prime importance is the *transparency* of "Lucite." Even in maximum thickness this colorless, crystal clear sheeting absorbs less than 1% of visible light. Its light weight, excellent tensile properties, resistance to chemicals and ease of forming, finishing and mounting make it suitable for a wide variety of aircraft applications.

WRITE FOR "LUCITE" MANUAL. This pocket-size, graphically illustrated guidebook lists physical properties of "Lucite" and shows most efficient methods of care and handling. For a free copy write on your business letterhead to E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, N. J., or 5801 South Broadway, Los Angeles 3, Calif. In Canada: Canadian Industries, Ltd., Box 10, Montreal.

Accident Prevention Speeds War Production



FLIGHT DECK ENCLOSURE OF "LUCITE." Used on B-24 and PB4Y-2 models. Transparent parts of "Lucite" are .250 inch thickness. Provides excellent optical qualities for the sides and top.

SWITCH GUARDS OF "LUCITE." On B-24, PB4Y-2 and PBY-5 models. In addition to its use as transparent enclosures, "Lucite" is used for guards to prevent accidental turn-offs of switches and instruments. Thicknesses of .125 and .250 inch are used.

DU PONT

DU PONT PLASTICS

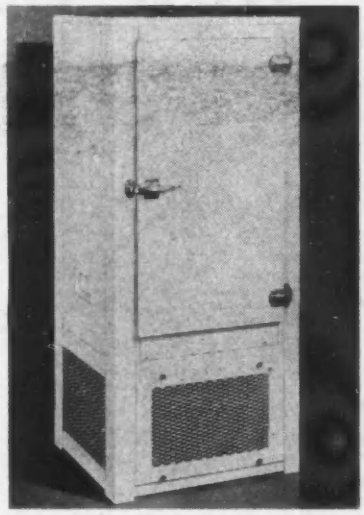
BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

New Products for Aircraft

Compact Refrigerator For Airplanes

The Airtemp Division of Chrysler Corporation is introducing a compact, custom-built refrigerator for airplanes. This 4¼ cu ft unit requires less than 3½ sq ft of floor area. Particular attention has been given to reducing weight to the minimum — consistent with structural strength—without loss in capacity or operating efficiency. The net weight of the unit is 106 lb. All of the parts of the Airtemp radial compressor are made of aluminum to conserve weight, except certain internal parts where aluminum is not practical.

The compressor is driven by a 1/5-hp electric motor of the special lightweight aircraft type connected to the compressor shaft by V-belt. This



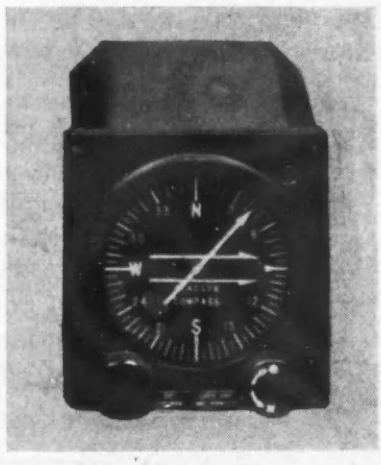
Airtemp refrigerator

1725 rpm shunt wound motor operates on 24 volt direct current but a dual voltage system is available which makes provision for the operation of the refrigerator, not only on 24 volt direct current, but also on 110 volt alternating current.

Sperry Gyrosyn Compass

The Sperry Corporation, New York, N. Y., has developed a new flight instrument, the Gyrosyn compass, which is a directional gyro synchronized with the magnetic field of the earth.

The Gyrosyn compass combines the functions of a directional gyro and a



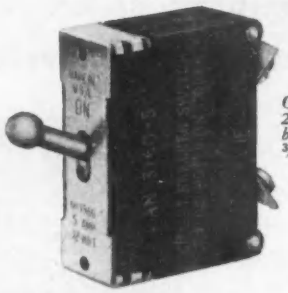
Sperry Gyrosyn compass

magnetic compass, and allows for dead-beat indication and accurate magnetic headings without northerly turning error or the necessity of resetting. It is an electrically driven directional gyro controlled by a Flux Valve. The latter is the "stand in" for a magnetic compass because it detects the direction

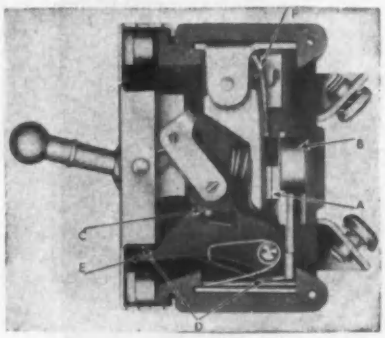
(*Turn to page 67, please*)

NEW! LITTELFUSE Circuit Breaker

Temperature - Compensating Bi-Metal Design Breaker practically free from effects of high and low ambients.



Overall size: 2⅛" x 2" deep below panel, x ¾" wide.



LITTELFUSE No. 1560 Circuit Breaker

Switch Type, Non-Trip Free. Conforms to Specifications AN-C-77. 5 to 50 amps., 32 volts, A. C. or D. C. HIGH LAG.

Side plate removed, handle in "On" position. Current passes from the upper terminal through copper wire into contact, and forward through U-shaped Bi-Metal "D," and lower terminal. Current causes Bi-Metal to heat and straighten out. Bi-Metal moves and pushes Latch-Block "E". When pushed far enough Latch "C" lets go, carrying contact to the left, opening circuit.

GREATER HEAT AND COLD RESISTANCE

Actual trip temperature* 350°F. Takes 60°F. below zero with very little variation.
*Without electrical load.

Overcomes common trouble of tripping in hot deserts where ambients as high as 180°F. are recorded. In high altitudes as low as -60°F., the breaker shows very little variation.

Simple, compact, dust and watertight, shock and vibration-proof. New design of Bi-Metal insures greater uniformity of performance by absence of friction and variable load. "Quick-make-quick-break" for minimum arc, and maximum pressure between contacts. Permanent magnet under bottom contact instantly blows out arc. Strong black bakelite case. Top and handle thick aluminum. Safe panel mounting.

Wide Range of Services

Designed primarily for war services, the high lag well adapts it to the protection of motors, tungsten lamps and other equipment of high starting surges—electrical systems of trains, 32-volt farm systems, many industrial and commercial applications.

Send for Littelfuse Circuit Breaker Bulletin, including Time-Current-Temperature characteristics.

Another Littelfuse unit for Complete Circuit Protection.

LITTELFUSE INC. 200 Ong St., El Monte, California 4757 Ravenswood Ave., Chicago 40, Illinois

Episode Near Luzon BY JAMES M. SESSIONS

NO. 10 OF A SERIES "HIGHLIGHTS OF WORLD WAR II" PRESENTED BY TUBE TURNS (INC.) LOUISVILLE, KY. SEE OTHER SIDE

FORGING'S PROBLEM CHIL... *Reformed*

Forgings of aluminum and other light-metal alloys have always been considered notoriously hard to handle. Many seemed to be too difficult to be practical. Yet today, at Tube Turns, they have been "brought into line" — and are being successfully produced in remarkable volume, and with highest precision! Perhaps you have a problem in forgings for wartime production — or looming in sight for the future. In either case, why not let Tube Turns help you with it? Broad experience, ingenuity and facilities all are here at your command. Equipment such as mammoth upsetters, powerful presses and the most modern heat-treat furnaces . . . plus original techniques . . . is ready to tackle and lick any forging job, however tough! Tube Turns (Incorporated), Louisville 1, Kentucky.

TUBE TURNS *Forgings for Industry*

In the painting reproduced on the reverse side, Artist Sessions has recaptured some of the stirring action which occurred off Luzon during the Jap invasion of the Philippines.

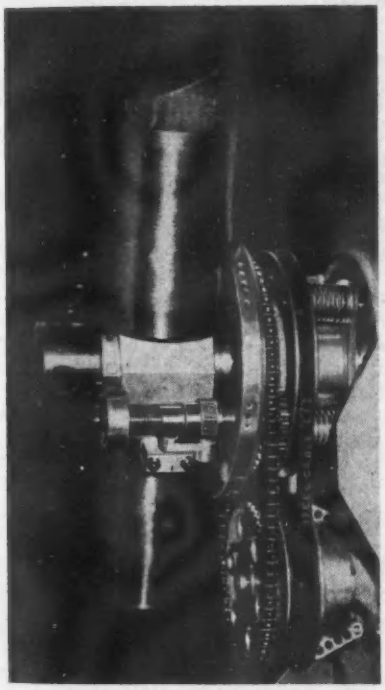
New Products for Aircraft

(*Continued from page* 64)

of the earth's magnetic field. Small, hermetically sealed and with no rotating parts, the Flux Valve may be rigidly mounted in a wing tip safely removed from the disturbing influences of the cockpit.

The Gyrosyn compass is installed on the pilot's instrument panel or at the navigator's station. Up to six repeaters for remote indications may be used with the new Sperry compass. The Sperry Gyrosyn compass with two repeaters weighs less than 12 pounds. Provision is also made for furnishing azimuth stabilization as required by any other equipment.

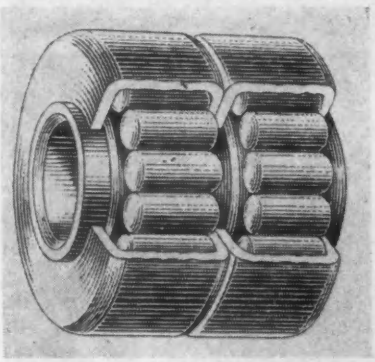
New Automatic Constant Speed Propeller



The Zimmer-Thomson Corporation, Long Island City, N. Y., is making what is said to be the first and only "self powered" constant-speed propeller offered at a low price to the postwar pilot and plane owner. It is named the Iso-Rev automatic constant-speed propeller, and utilizes the "V-belt on split pulleys" principle for actuating the pitch changing mechanism.

Needle Bearings for Aircraft Pulleys

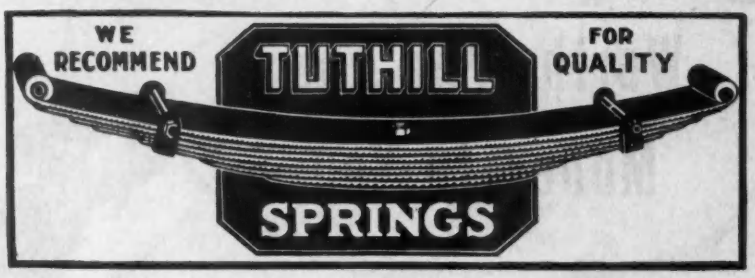
A double row PN needle bearing, which is said to have a friction coefficient as low as that of any other type anti-friction bearing, has been announced by The Torrington Company, Torrington, Conn., as specially designed to minimize friction in aircraft pulley applications. Fully conforming to all requirements of Specifications AN-FF-P-796, this recent addition of the Torrington line of needle bearings offers several advantages for aircraft pulley use.



Torrington Type PN needle bearing

The full complement of small diameter needle rollers provides ample capacity to meet all standard government and individual aircraft company requirements, and the small outside diameter of the bearing contributes to weight-saving features in the design of anti-friction aircraft pulleys.

Another advantage is the efficient



Why we recommend TUTHILL as a Quality Spring—

QUALITY is its own best argument. It proclaims in service the fact that it embodies the best in *design, materials* and *workmanship.* It is the thing most desired by user and manufacturer alike—the binding link in service and good-will. Here's why we claim Quality for TUTHILL:

1. ***Material control.*** Each shipment of steel from which Tuthill Springs are made is inspected to see that it conforms to S. A. E. standards based on chemical analysis.

2. ***Superior heat treatment,*** pyrometer controlled, insures right tempering, correct hardness, toughness and resilience. Continuous heating and tempering furnaces, modern in every way, temper and toughen Tuthill Springs.

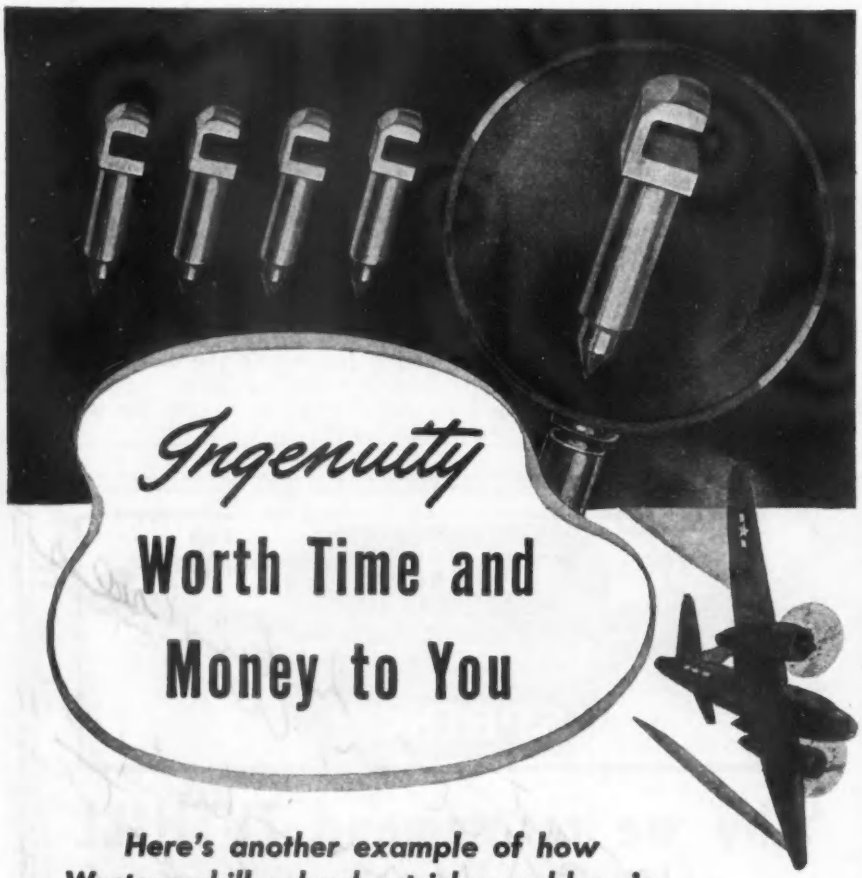
3. ***Shot blasting.*** New conveyor type of Shot-Peening equipment is used to give added strength and longer life to Tuthill Springs.

4. ***Experience.*** Sixty-four years of constant progress in improved methods and heat treatment insures exceptional performance under all load and service conditions.

TUTHILL not only manufactures a complete line of standard leaf-type springs, but also makes to order special types of springs to meet your specifications. Advise your requirements and let our engineers submit specifications, with recommendations.

Submit your Spring problems with details

TUTHILL SPRING COMPANY
763 W. Polk St.
CHICAGO 7, ILLINOIS



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● It's an airplane carburetor float needle and of course it must work perfectly — nothing less will do. But when it was lapped at assembly with its mating piece, the abrasive action wore a tiny groove at the seating line. Not good in a plane that's miles from its base chopping up Nazi transport — it would have a tendency to stick. But Western engineers worked out an ingenious grinding operation that eliminated the lapping entirely, with smooth finish precision results that met the specification of individual dry-seal vacuum tests — airtight support of a 10″ mercury column . . . This kind of skill can be highly valuable to you now, *but especially postwar*. It is not expensive — get our quotation on your next need.

Western Service is Complete

We manufacture special precision screw machine products to specifications. Machine capacity ranges from 1/16″ to 4 5/16″ round, with complete equipment for all types of secondary and processing operations, including precision grinding, heat-treating, hardening and pentrating.

Aircraft Products Division

Western Automatic Machine Screw Company

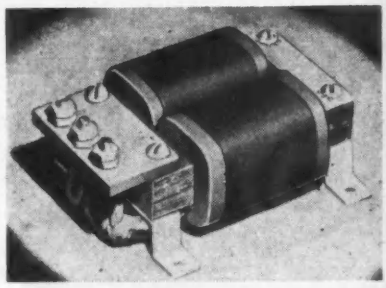
Elyria, Ohio, U. S. A.

Precision Parts and Assemblies Since 1873

lubrication of the PN needle bearing. Its enclosed design provides ample space for retention of the lubricant—without danger of excess grease being present, which would impede operation at low temperatures.

Autotransformers for Aircraft

A new line of general-purpose single-phase autotransformers, recently brought out by General Electric Company, Schenectady, N. Y., has been designed especially for operation from line-to-neutral of 400-cycle, 120/208 Y-volt, aircraft electrical systems.



G-E autotransformer

They are small in size, lightweight, and particularly adaptable for operation of 28-volt lamps, electrically heated flying suits, and other low-voltage aircraft accessories.

The small size and light weight of these autotransformers are made possible by the combination of a new core steel and glass insulation impregnated with a new inorganic resin.

Suitable for operation at any altitude from sea level to 60,000 feet, they are said to function properly in temperatures from —40 F to 140 F. They are satisfactory for operation over a frequency range from 380 to 420 cycles, and are suitable for continuous use at an overvoltage of five per cent.

New Thinner, Lighter De-Icer Announced

The B. F. Goodrich Company, Akron, Ohio, is making a new type De-Icer which is not only thinner and lighter than former models but is also a more efficient ice breaker. Known as Type 11, the new version of the pulsating-boot ice breaker has been approved by the Civil Aeronautics Administration and the Army Air Forces. Like previous De-Icer models, it is attached to the leading edges of wing and tail surfaces and contains tubes which expand and contract at the operator's will, breaking up the ice and causing it to be carried away by the airstream.

An over-all ply of special elastic fabric in the new De-Icer greatly increases its resistance to tearing, and by enclosing the wire bead at the attachment edge in the special ply, a thinner cross-section has been made possible, which is said to improve the De-Icer aerodynamically.

(*Turn to page* 88, *please*)

EXAMPLE OF *Service*:

A Cities Service Lubrication Engineer, called in by a large war plant, suggested certain changes in threading operations . . . recommended a new *transparent* blend of Cities Service Cutting Oil . . . and thus almost tripled the number of pieces per grind.

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and *Cities Service* means good service!

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ARKANSAS FUEL OIL COMPANY

SAE T&M Meeting

(*Continued from page* 41)

for the Diesel engine (in same size coach) was 0.11 cents less per mile. In addition to greater economy they have proved far more reliable and free from failures on the road than gasoline engines.

Irrespective of the engine used the "engine power to vehicle gross weight" ratio is exceedingly important. There have been many coaches put on the market that have been well designed in every respect but have not had sufficient power; therefore, they have not been acceptable to the operators especially in the West.

Regardless of the type of engine used there are several so-called accessories that are definitely important. They are: 1. A centrifugal governor designed for accuracy and reliability. Incorporated within the governor should be a device that in the event the engine over runs the governor going down grade and electrical contact is made and the driver is warned by a buzzer. 2. Oil filters of adequate size. An oil filter properly designed for a given engine should be built with consideration given to the oil pump capacity that a majority of the oil is not by-passing. Also, the oil filter should be directly attached to the engine in order to eliminate the necessity of any oil lines or flexible tubes. 3. A reliable and well constructed low oil pressure indicator directly attached to the engine and connected to a warning light or buzzer adjacent to the driver. 4. Engine temperature indicator connected to a buzzer warning the driver when overheating develops. 5. Engine tachometer with the indicator placed within the driver's vision.

Designers should develop seats that have space underneath for limited pieces of baggage. Whatever baggage is carried inside the coach by the passenger eliminates handling by company employes and the attendant liabilities. The greatest improvement that could possibly be made, with respect to passenger comfort, would be the permission to build coaches 100 in. wide. Due to the 96 in. width, the width of the seats and aisle are limited.

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Postwar Expectations and Possibilities of Air Borne (Helicopter) Bus Service

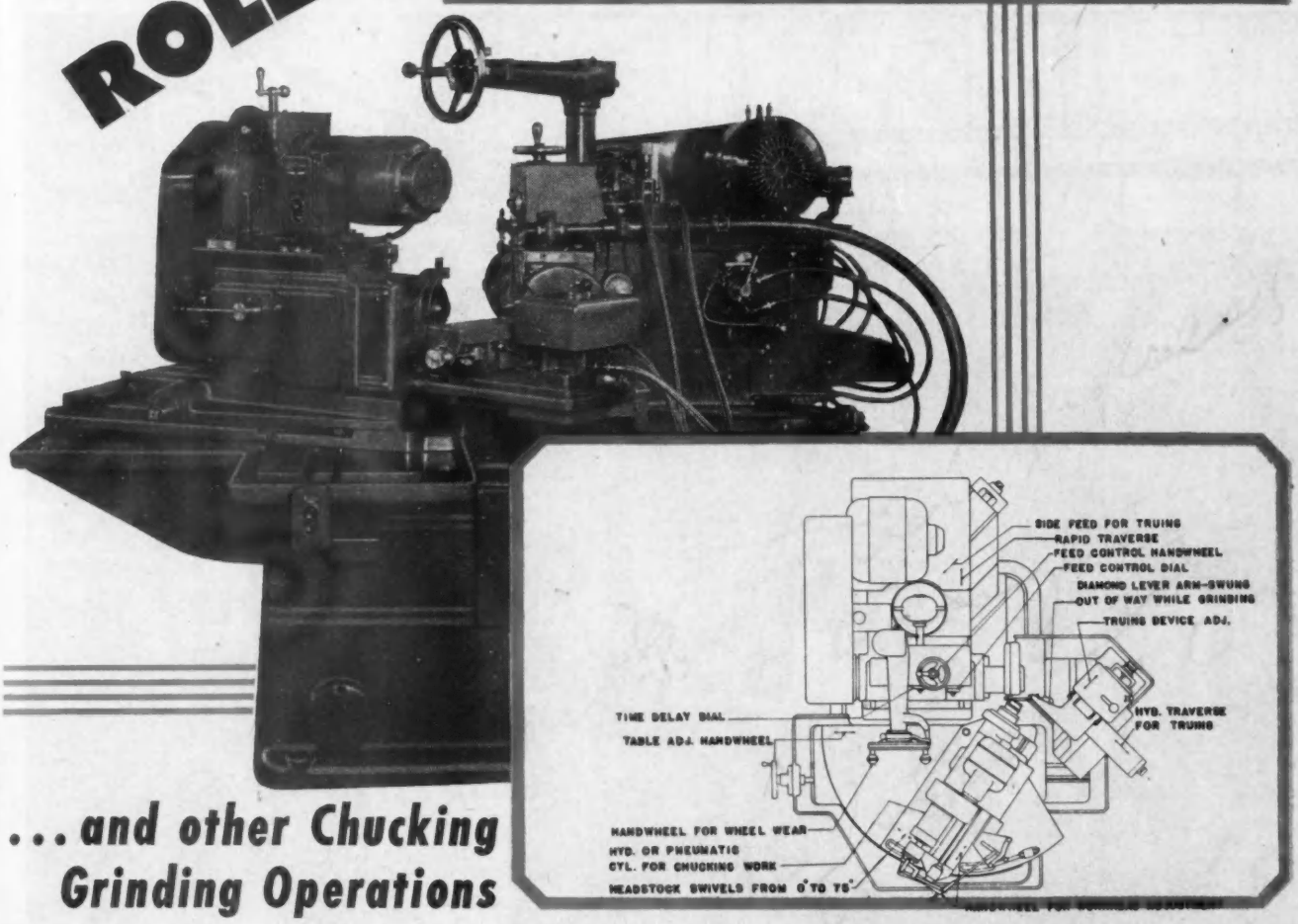
By Agnew E. Larsen, President, RotaWings, Inc.

THE economics of the helicopter will present many questions that are as yet unanswered, and they cannot be answered until the technical development is much more advanced. But if no serious technical difficulty and no barrier of excessive operating costs develops, it at least appears that for a considerable portion of the possible local transport routes the helicopter's shortcomings in speed as compared with the airplane will be substantially offset by its advantages in the saving of time on the ground and in certain phases of flight and in saving in travel time to the airport.

A recent survey of the proposed Helicopter routes of the Burlington Transportation Company as submitted in their application for a certificate of operation before the Civil Aeronautics Board reveals some interesting facts. Out of some 70 cities surveyed, with 65 appearing in the application, well over 85 per cent had ample operating and landing facilities, the bulk of which were actually on property owned by the Chicago, Burlington & Quincy Railroad Co. This property in most cases required only a minimum of preparation expense, in the form of minor grading or surfacing preparation, the removal or relocation of obstacles which interfered with or impaired the safe approaches required for helicopter operation.

This situation of adequate operational sites, suitable for helicopter-air-

GRIND ROLLER BEARING RACES ON A FITCHBURG


SIDE FEED FOR TRUING
RAPID TRAVERSE
FEED CONTROL HANDWHEEL
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DIAMOND LEVER ARM-SWUNG OUT OF WAY WHILE GRINDING
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HEADSTOCK SWIVELS FROM 0° TO 75°

. . . and other Chucking Grinding Operations

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The Fitchburg Roller Bearing Race Grinder is completely automatic. By pressing a single button the wheelhead goes through its standard automatic cycle — rapid traverse to the work, proper grinding feed, spark-out time, and rapid return. Work is held to limits of .0002" in production.

The workhead can be arranged either hydraulically or pneumatically for collet clamping or other chucking devices.

In this taper grinding application, the wheelhead is mounted on a 45° slide for trueing. The trueing device is mounted on the side of the base parallel to the wheelhead, and is hydraulically operated for trueing, with micrometer adjustment for positioning.

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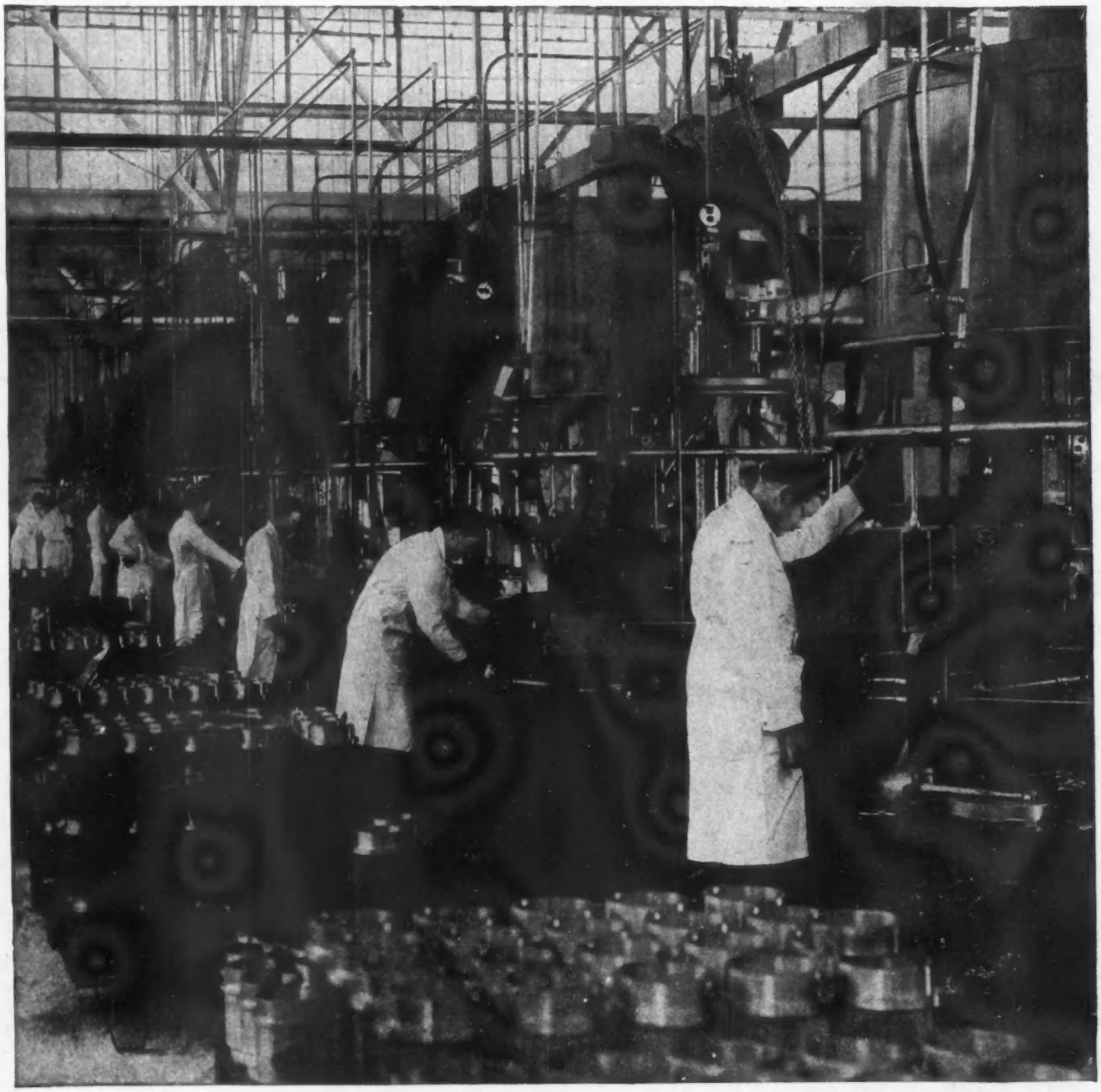
A CHANGE-OVER



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Army Service Forces Bulletin, P.S. No. 300

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HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

bus transportation directly into communities is something unique in the history of air transportation and is associated immutably with the particular flight characteristics of the helicopter—and absolutely unattainable to the airplane, in any form.

Technical Approach to the Utilization of Wartime Motor Fuels

By W. H. Paul, Professor of Automotive Engineering, Oregon State College

As a result of war needs for petroleum, it has been found necessary to alter some of the physical and chemical properties of motor gasoline in order to make available certain light petroleum fractions needed for such items as high output fuels, synthetic rubber, explosives, plastics, etc. These changes, particularly in volatility and anti-knock quality have so markedly affected the operation of motor car engines that every vehicle operator is well aware of impaired performance.

As a summary on comparisons of pre-war and present gasolines, the following general statement can be made. (1) No deleterious effects in engine operation should be encountered from minor changes which may have been made in gravity, vapor pressure, sulphur, or gum. (2) Present-day premium fuel is about equal in knock resistance to pre-war regular grade; the two classes of fuel are now separated by only 3.5 octane numbers instead of 9.0 as before. This lowered octane rating does not affect the 35 mph level road operation of passenger vehicles, as their octane requirement at such low load factors is considerably below 70. (3) The volatility of present-day gasoline has been lowered over the greater portion of its boiling temperature range; it is now inferior in this respect to pre-war third structure grade.

The lowered volatility is not a cause of crankcase oil dilution. This is at variance with numerous reports from operators claiming increased dilution, dating from the approximate time when low volatile fuels appeared. The dilution is probably traceable to operational procedures, such as more cold starts per 100 miles and decreased effectiveness of crankcase ventilating systems at lowered speeds, rather than to an excess of heavy ends in the fuel. (4) A small increase in temperature can increase, by an appreciable amount, the quantity of fuel evaporated. Observe the equilibrium air distillation (EAD) curves (Fig. 1). In the case of the EAD curve for wartime gasoline, if the temperature is increased to 130F, just 18F more, the remaining 25 per cent of the fuel will be evaporated.

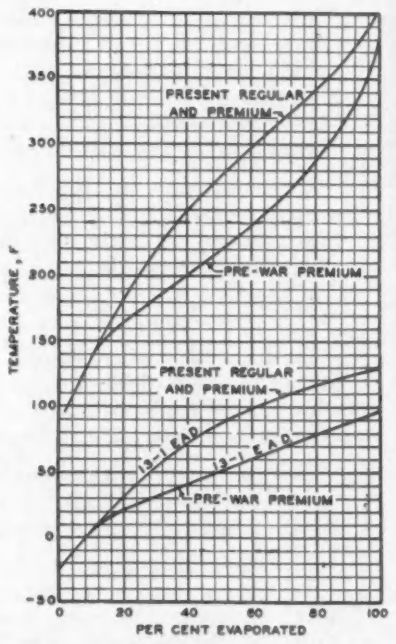

Fig. 1—ASTM and corresponding equilibrium-air volatility of present and pre-war gasolines.

This type of analysis provides the basis for design of intake manifolds adaptable to fuels of various known volatilities.

In order to compare the actual mixture temperatures during the warm-up period with those calculated in equilibrium-air distillation for present-day gasoline, a limited number of road tests were made. Thermocouples were installed on the engine at three locations,

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1 Added strength.
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4 We have had no galling at random assembly of several hundred studs per case.
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8 A.N. and Whitworth tapped holes accept the same A.N.D. stud. All can be demonstrated in your shop.

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(1) in carburetor air horn, after the air cleaner, (2) in the mixture stream after the hot spot, and (3) in the jacket coolant on the engine side of the thermostat. The procedure consisted of a one minute stationary warm-up period, at approximately 1000 rpm, followed by a level road run at 35 mph in high gear. Readings of the three temperatures, referred to above, were taken at one minute intervals until steady conditions were obtained. Typical warm-up curves such as those shown in Fig. 2 were plotted from the test data. It is interesting to compare

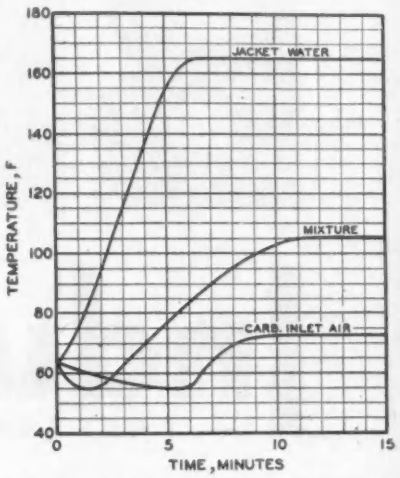

Fig. 2—Warm-up curves from road test of 1941 model car having an exhaust type manifold heater.

the rapid rate of temperature rise for the jacket water with the lower rates of both the mixture and the carburetor inlet air temperatures. Further, it is seen that the mixture temperature does not reach equilibrium until approximately ten minutes have elapsed.

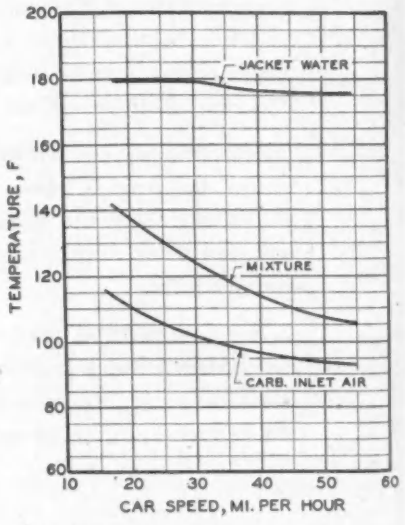

Fig. 3—Effect of car speed on operating temperatures.

Fig. 3 calls attention to the effect of speed on the final steady temperatures attained by the carburetor inlet air, the mixture, and the jacket water. These observations were made on a car hav-

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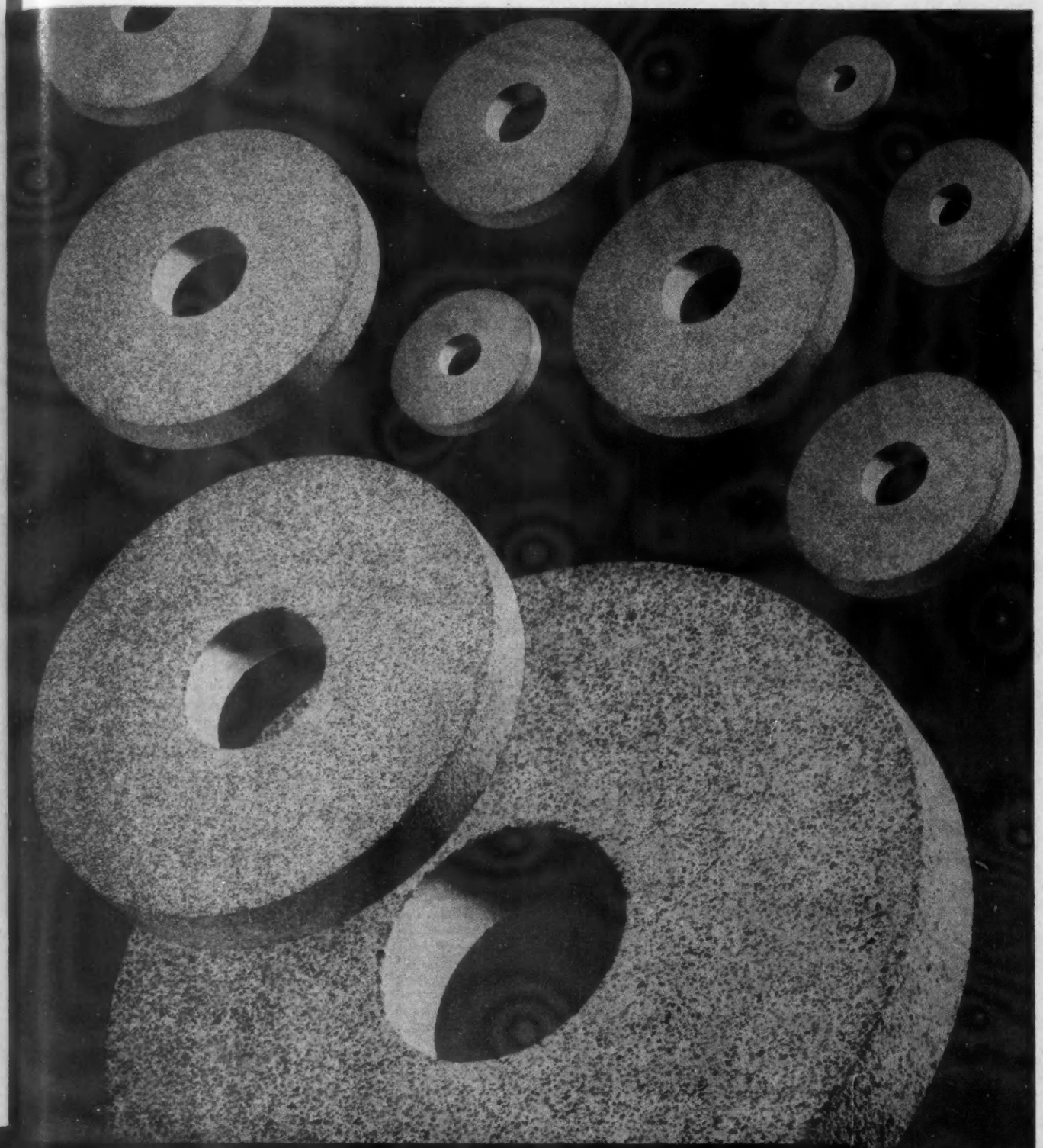

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ing a water-jacketed intake manifold and equipped with a 180F thermostat. Note that the mixture temperature falls off with increased level-road speed. This fact might be useful in the development of any device designed to increase mixture temperature.

On water-jacketed manifolds, some advantage can be gained by installing high-temperature thermostats in the cooling system. Fig. 4 shows two sets of warm-up curves obtained under the test conditions previously described. By increasing the jacket temperature 15F, the inlet-to-carburetor temperature was increased from 74F to 86F, despite the lower atmospheric temperature of 55F instead of 65F. Had the atmospheric temperature been 65F it is likely that the carburetor air temperature would have exceeded 90F. Of principal interest, however, is the rise in temperature of the mixture from 110F to 118F. The eight deg rise is capable of evaporating an additional 12 per cent of the fuel according to Fig. 1. In support of the reasonable accuracy of the test methodss here employed it was noted that the throttle response, although not up to standard, was greatly improved by effecting this temperature change. If the mixture temperature could be made

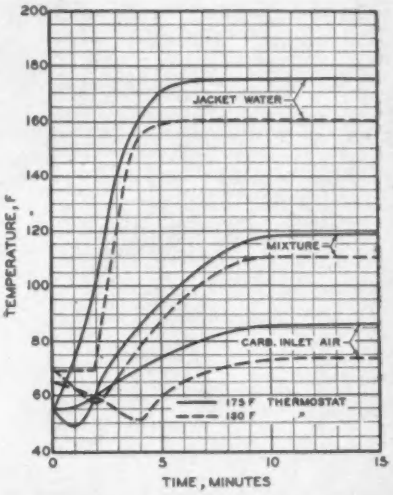
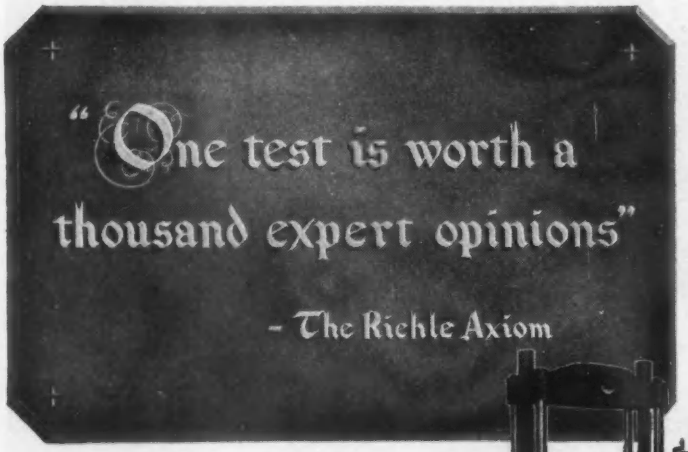


Fig. 4—Effect of jacket temperature on warm-up mixture temperature. Tests with 1941 model car having water jacketed manifold.

to rise at a more rapid rate the warm-up period could be reduced. The 175F thermostat did reduce this time by about 1.5 minutes but better results than this should be obtained.



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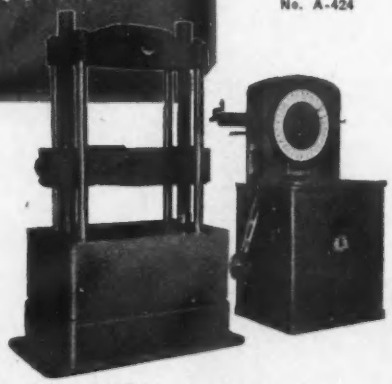

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Future Gasoline Engines

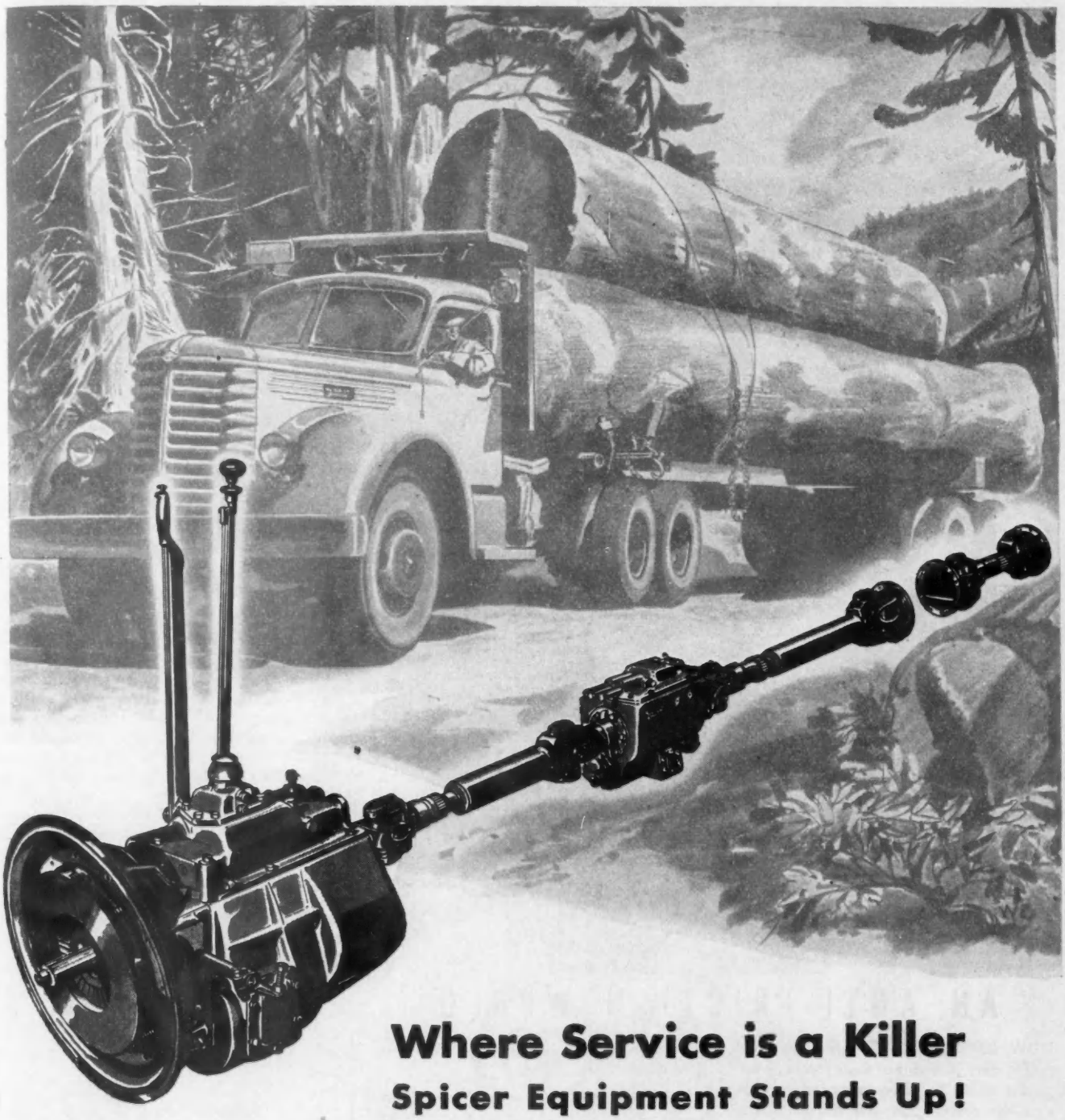
By **Forest S. Baster**, Vice President in Charge of Engineering, The White Motor Co.

CONSIDERATION of the engine of the future must be based on fuels available as well as materials available. For this engine of the future we believe that the non-premium gasoline will be at least 90 octane and the lighter alloys (aluminum and magnesium) will be priced competitively with cast iron. The 90 octane fuel will be far superior in *road* performance to the 87-90 octane fuel which was available before the war as aircraft gasoline.

Engines will, in all probability, be no smaller physically than those now in use but will have considerably higher output. It is conceivable that we shall have engines developing 165 bmep unsupercharged and 200 bmep supercharged with 0.55 to 0.60 hp per cu in. in the normally aspirated engine and even more in the supercharged version. These higher outputs will be needed for, after the close of hostilities, this nation will undoubtedly have an era of road building which will produce main inter-sectional and transcontinental roads which will permit high speeds and this in turn may lead to legislation as to minimum speeds which must be maintained even on the upgrade.

There are quite a number of ways in which additional performance can be obtained. With the increase in compression ratios, for instance, spark timing will perhaps become much more exact than that given by our present day distributors with their rather wide tolerances as built in today's production. There are at least two and possibly three different ways known at the present time by which distributor points

(*Turn to page* 180, *please*)



Where Service is a Killer

Spicer Equipment Stands Up!

On the work fields of the home front, just as on the battle fields of war fronts, Spicer Transmissions, Auxiliary Transmissions, Universal Joints and Propeller Shafts are standing up under the most gruelling, punishing service ever imposed upon power transmission equipment. Where power delivery must not fail, and where motor vehicles must get through to deliver the goods, Spicer products are a "must" in the equipment specification. Spicer will be ready to resume immediately its large-scale production for civilian needs, when wartime needs are fully met. Spicer Manufacturing Corporation, Toledo, O.

41 YEARS OF Spicer SERVICE

BROWN-LIPE CLUTCHES AND TRANSMISSIONS • SALISBURY FRONT AND REAR AXLES

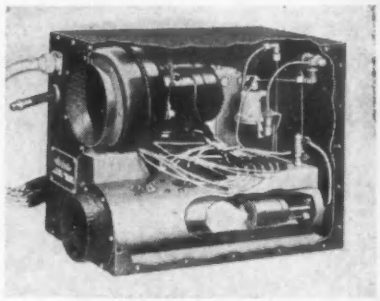
SPICER UNIVERSAL JOINTS • PARISH FRAMES, STAMPINGS

New Products

Truck Heater Pre-Heats Engines

The Model SAH heater, just brought out by Anchor Post Fence Co., Baltimore, Md., combines the usual functions of cab heating and windshield defrosting, with the addition of trailer space heating and pre-heating of batteries, engine manifold and crankcase as desired. This heater is made in several different sizes with outputs from 10,000 Btu-hr on low rate to 40,000 Btu-hr when firing at maximum rates. Control is remotely mounted.

The combustion process of vapor entraining is used. The heat exchanger has four compartments with "cross-over" passes between. Thus the flame and hot gases have a travel of four times the length of the heat exchanger with the maximum area of heating surface exposed to the heating air. Combustion air is pre-heated in a tube which extends through the length of one exchanger compartment. Fuel is drawn from the vehicle's supply tank.



Model SAH heater

AN ANTI-FRICTION WORLD

NOW IS THE TIME! Alert manufacturers, determined that their products and plants shall be fully prepared to meet post-war competition, are drawing liberally on Aetna's long experience in the conquest of friction.

Conquering friction—in no other respect has industrial science made more practical strides than in the broader use of anti-friction bearings; better designs, more efficient applications, faster and better methods of manufacture—vital improvement with which Aetna has had much to do.

How you, too, can utilize these betterments to the advantage of your plants and products—that is exactly where Aetna's engineers can serve you. Isn't it worth talking about? Aetna is ready—and now is the time. AETNA BALL BEARING MANUFACTURING CO., 4600 Schubert Ave., Chicago 39, Ill.

IN DETROIT 2: SAM T. KELLER, 7300 Woodward Ave., Madison 8840-1-2.

MAKERS of THRUST BALL BEARINGS, *Standard and Special* ANGULAR CONTACT BALL BEARINGS ROLLER BEARINGS . . . *Special,* BALL RETAINERS HARDENED *and* GROUND WASHERS

ARMY NAVY

Aetna BALL BEARINGS

Cast-to-Shape Tool Steels

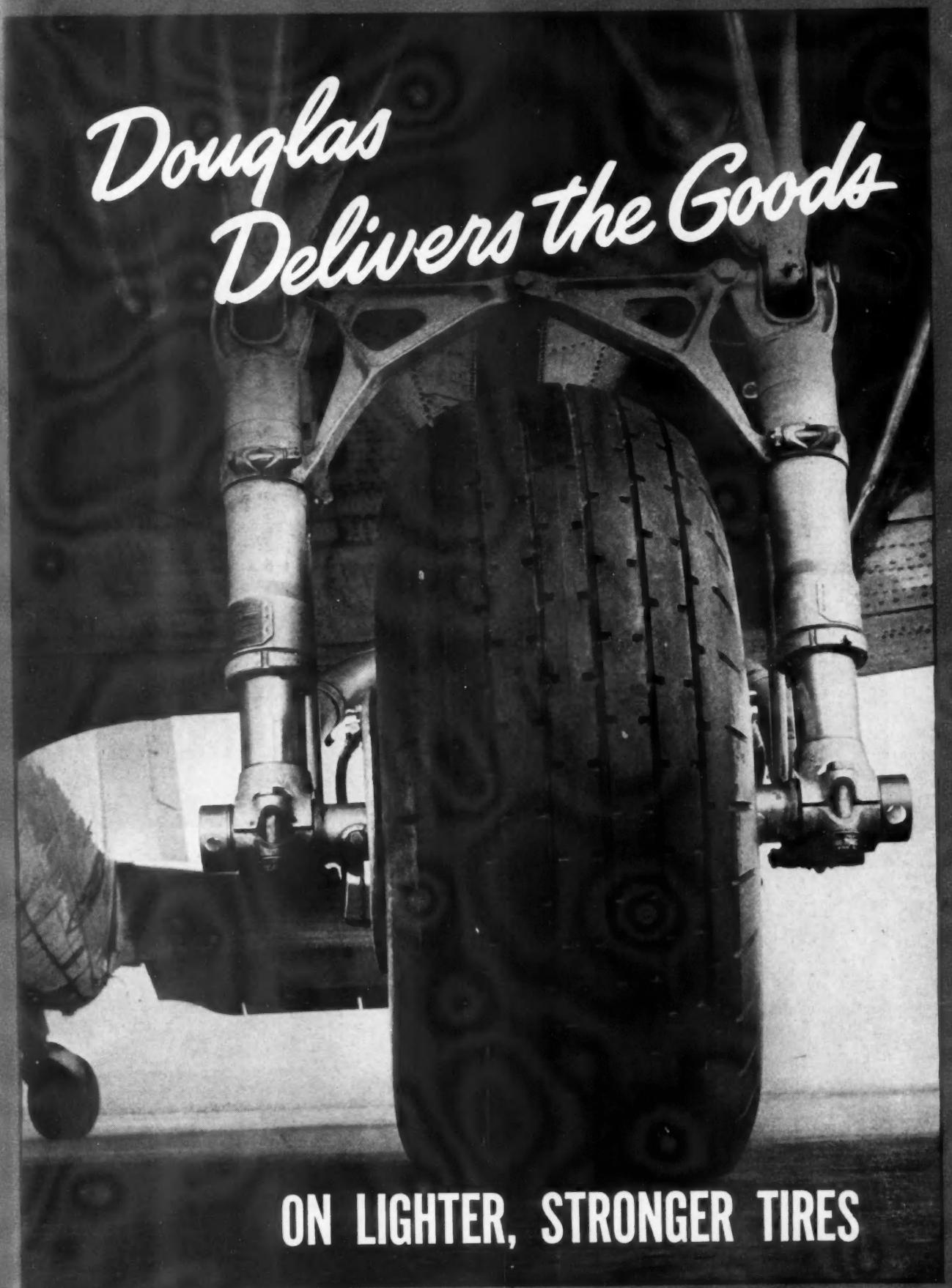
Tool steels are now being cast-to-shape for commercial applications by the Jessop Steel Company, Washington, Pa. Jessop tool steels cast-to-shape are used for dies, forming tools, glass molds, gages, hobs, gears, cams and numerous other items. All castings are furnished in the annealed condition to facilitate machining.

Standard types of tool steel castings are regularly being made of air harden-

Tool steel castings made by Jessop Steel Co.

ing, oil hardening, flame hardening, stainless and heat resistant analyses. Many other analyses of specialty steels are available nd even the user's "tailor-made" specifications may be cast to shape. When large castings are poured, the heaviest sections are cored out and, in addition, reinforcing ribs are used for added strength.

(*Turn to page 87, please*)



OFFICIAL U. S. NAVY PHOTO

UNITED STATES RUBBER COMPANY

1230 SIXTH AVENUE
ROCKEFELLER CENTER
NEW YORK 20, N. Y.

"Box Car" Capacity

DELIVERS MORE MEN,

OFFICIAL ARMY AIR FORCE PHOTO

... AND LIGHTER, STRONGER TIRES CARRY THE LOAD

Wherever the Army Air Transport Command, Troop Carrier Command and the Navy Air Transport Service fly men and supplies, Douglas transport planes deliver the goods. The giant C-54 with its "box car" dimensions and the veteran C-47, military version of the airlines' DC-3, are transporting loads of troops and top priority materiel that give new scope to global warfare. With no change in tire size, these great planes are carrying heavier loads today than ever before... and landing them on every type of runway. Wherever Douglas transports fly, U.S. Royal Airplane tires are on the job.

OFFICIAL U. S. NAVY PHOTO

LESS THAN 48 HOURS to the South Pacific. The Army Air Transport Command and the Navy Air Transport Service flying Douglas "Skymasters", speed giant loads of men and materials to all world fronts.

1230 SIXTH AVENUE **UNITED STATES**

ENGINEERED BY DOUGLAS

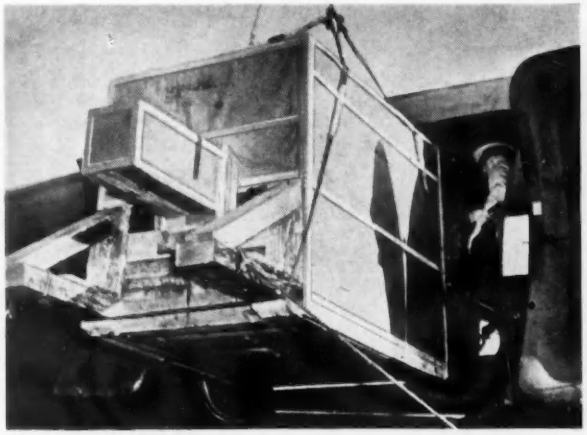
MORE SUPPLIES...ON TIME

From whole airplane wings to engines, top priority cargo is loaded into Douglas "Skymasters" and rushed to the corners of the world. Built to carry 12,650 pounds of pay load 3000 miles non-stop, the "Skymaster" often loads in 20,000 pounds and more.

Every pound of extra load means more work for airplane tires on every take-off and landing. To give this extra reserve of strength, "U.S." pioneered the lighter, stronger rayon cord construction... now the standard of the Service.

OFFICIAL U. S. NAVY PHOTO

2000 HORSES ABOARD! An urgently needed airplane engine is loaded into the cavernous hatch of a Douglas "Skymaster" destined for a distant front.

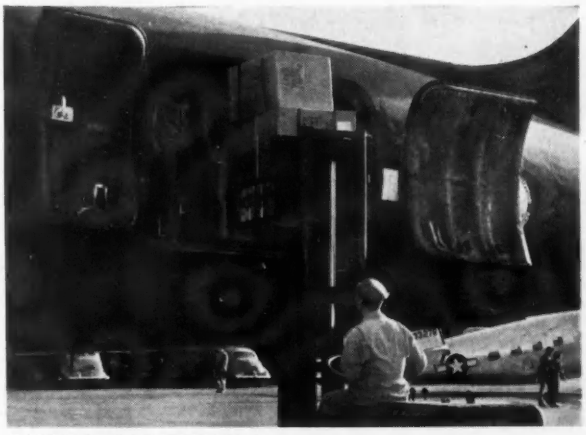


OFFICIAL U. S. NAVY PHOTO

"BOX CARS" IS RIGHT! A generator rotor weighing 8900 pounds, one of the heaviest individual items ever carried by air, starts for Panama in a Douglas "Skymaster" flown by NATS.

OFFICIAL U. S. NAVY PHOTO

HOSPITAL SHIP! The Army Air Transport Command flies wounded and sick fighting men swiftly from remote South Pacific island in Douglas "Skymasters"



OFFICIAL ARMY AIR FORCE PHOTO

"SKYMASTER" LOADS! The "box car" capacity of this Douglas "Skymaster" is being loaded with urgently needed supplies for our fighting men. Douglas delivers the goods.

RUBBER COMPANY ROCKEFELLER CENTER • NEW YORK 20, N. Y.

OFFICIAL U. S. NAVY PHOTO

DOUGLAS "DAUNTLESS" DELIVERS, TOO, ON U. S. ROYAL AIRPLANE TIRES

The Douglas "Dauntless" dive bomber delivers a different kind of cargo...a 1000-pound bomb. Though production of the SBD has ceased, thousands of Douglas "Dauntless" dive bombers are still in action and will go on to establish one of the most magnificent combat records ever set by one type of warplane. In the Battle of Midway, SBD's sank four Jap carriers and from Pearl Harbor over the whole Pacific area, they carried destruction to the enemy.

On the "Dauntless", on the "Skymaster" and on the C-47, lighter, stronger U.S. Royal Airplane tires contribute their part in making landings and take-offs safer under heavy wartime loads... from coral runways or from carrier decks.

Listen to the Philharmonic-Symphony program over the CBS network Sunday afternoon, 3:00 to 4:30 EWT Carl Van Doren and a guest star present an interlude of historical significance.

Serving Through Science . . . To Speed The Victory

This is the under-carriage of the Douglas "Dauntless" equipped with U.S. Royals. Dive bomber, fighter or transport, there is a U. S. Royal engineered for every airplane tire job.

UNITED STATES RUBBER COMPANY

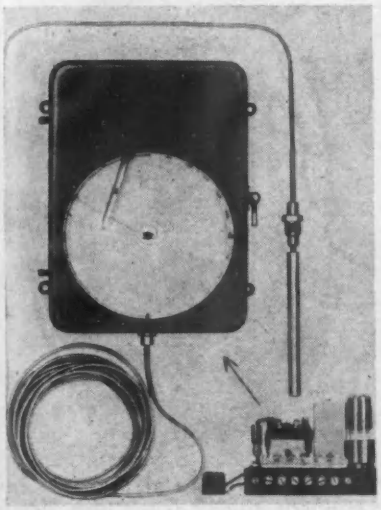
1230 SIXTH AVENUE · ROCKEFELLER CENTER · NEW YORK 20, N. Y.

New Products

(*Continued from page* 82)

Electronic Automatic Control Instruments

An electronic-type controller, known as Bristol's free-vane electronic controller, has just been placed on the market by The Bristol Company, Waterbury, Conn. The new line of controllers operates on the shielding effect of a vane passing between two coils in an electronic circuit. Recording and indicating models are offered for automatic control of temperature, pressure, liquid level, and humidity. The following types of control operation are available: low-open, high-open, low-high, low-open-high, and low-normal-high.



Bristol free-vane electronic controller

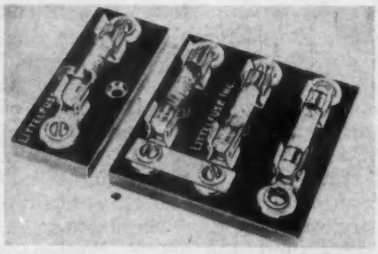
Fiberglass Plastic for Electrical Applications

The Formica Insulation Company, Cincinnati, Ohio, has developed and is producing a fiberglass plastic, for electrical applications, known as GMG-17-P-5. The glass-base plastic is made from a fine weave of continuous filament fiberglass fabric with a thermosetting resin which is said to be more resistant to flame and to arcing than resins ordinarily used in standard grades of laminated material.

The material available now in sheets, tubes and rods is specially designed for electrical applications which require a high order of flame and fire resistance, together with a high arc resistance and high mechanical strength. The Formica fiberglass laminate is available in sheets 3 ft wide in lengths of 36, 42, 84, and 96 in. Thicknesses range from 1/32 in. to 2 in.

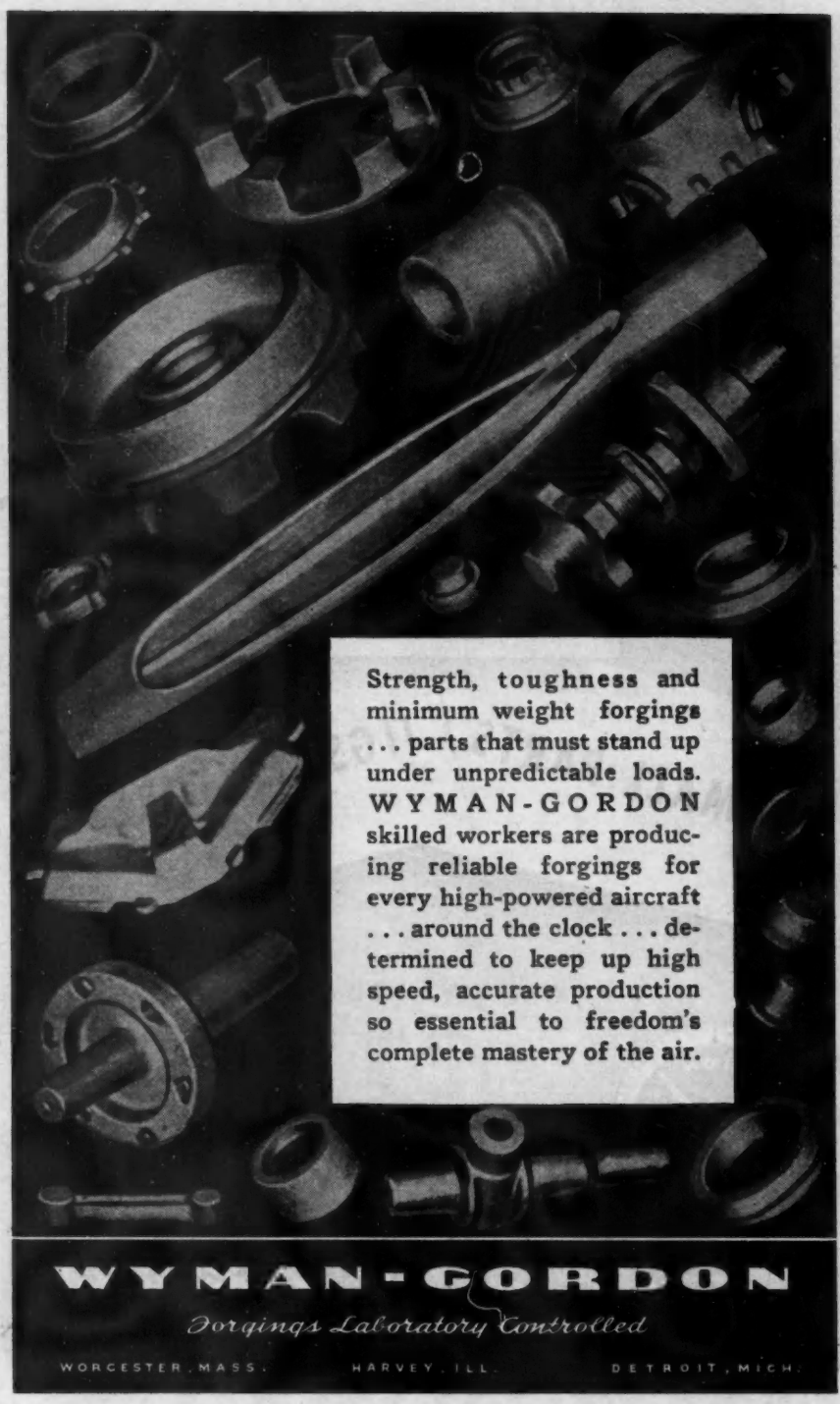
Time Saver in Fuse Panels

Littelfuse, Incorporated, Chicago, Ill., offers a new improved Littelfuse universal fuse panel, No. 1505, blueprints for which are now available to manufacturers making or using electrical equipment, engineers, draftsmen, prime contractors, and purchasing agents, on request.



Typical Littelfuse universal fuse panels

Littelfuse universal fuse panel No. 1505 is for Littelfuse 3 A G and 3 A B, 4 A G and 4 A B, and 5 A G and 5 A B Aircorps type of fuses and clips. One number covers the mounting. The user has only to take the blueprint and in a few moments check all the factors for panels precisely to his individual specifications. First dash number indicates fuse specification. Second dash number specifies number of poles. Specifications include bus bars if required, and number of poles to be bussed. Panels to individual specifications, meeting all Air Corps require-


Strength, toughness and minimum weight forgings . . . parts that must stand up under unpredictable loads. WYMAN-GORDON skilled workers are producing reliable forgings for every high-powered aircraft . . . around the clock . . . determined to keep up high speed, accurate production so essential to freedom's complete mastery of the air.
WYMAN-GORDON
Forgings Laboratory Controlled
WORCESTER, MASS.
HARVEY, ILL.
DETROIT, MICH.

ments come ready to mount, equipped with terminals and fuse clips or terminal studs.

Kodak Photo-Layout Materials

Materials for a simplified method of printing working drawings directly on metal have recently been introduced by the Eastman Kodak Co., Rochester, N. Y. These are kodak layout paint and kodak layout paint primer. As the name of the latter implies, it acts as a subbing base for the layout paint.

Kodak layout paint is sprayed in ordinary room light directly on virtually any primed metal surface with a conventional spray gun, after the surface has been cleaned reasonably free of loose dirt and grease. Drying takes place rapidly and the prepared metal is ready for immediate use or it can be safely stored for a reasonable time in a dark place.

The drawing, which has been previously prepared with black ink on a transparent or translucent material, is next laid in contact with the prepared surface and an exposure of a few minutes duration made to arc or mercury vapor lights. The drawing is removed and the metal flooded with warm, weak ammonia water. A vigorous spray of water follows which washes away the entire exposed coating, leaving only white lines where black lines appeared in the drawing. Another thin spray coat of layout paint primer protects the finished product.

Goodyear Hi-Miler S-Rib

Here is a closeup of the tread for synthetic rubber truck tires, developed by the Goodyear Tire and Rubber Company. The new tread, Hi-Miller S-Rib, was developed especially to meet the peculiarities of synthetic rubber rather than a new attempt to adapt methods used in the tread designs of natural rubber tires.

New Products for Aircraft

(*Continued from page* 68)

Chemical Lacquer for Propeller De-Icing

A chemical de-icing lacquer for aircraft propellers is a recent development by Hamilton Standard Propellers division of United Aircraft Corporation, East Hartford, Conn.

The new de-icer, now being manufactured under the name of Icelac, is painted or sprayed on propeller blades, and by means of chemical action is said to afford protection from icing conditions for long periods of time.

Icelac is black in color, has a consistency about like that of glycerine, and paints or spreads freely, drying with a shiny tacky surface. A satisfactory surface can be maintained on blades with little or no maintenance, giving protection down to temperatures below zero Fahrenheit. Ice-releasing chemicals in the compound eventually become exhausted in the film, the condition becoming apparent when the substance loses its sheen. Additional coats are then applied.

AIRCRAFT HYDRAULICS

For every aircraft hydraulic unit made to proprietary design, there are two made to airframe manufacturers' design.

Although we do considerable design work, we frequently manufacture units which have been completely designed and detailed by the plane builder.

Illustrated here, are three aircraft hydraulic units; an engine cowl flap cylinder and two automatic control valves. Each of these units was wholly designed by the plane builder. We have produced large quantities of these units on extremely short schedules.

The control valves have permanent moulded aluminum bodies. The cylinder has a forged aluminum cap. Pistons and sleeves are precision ground and lapped to fits of .0002-in. The completed units operate on 1500 p.s.i. pressure system.

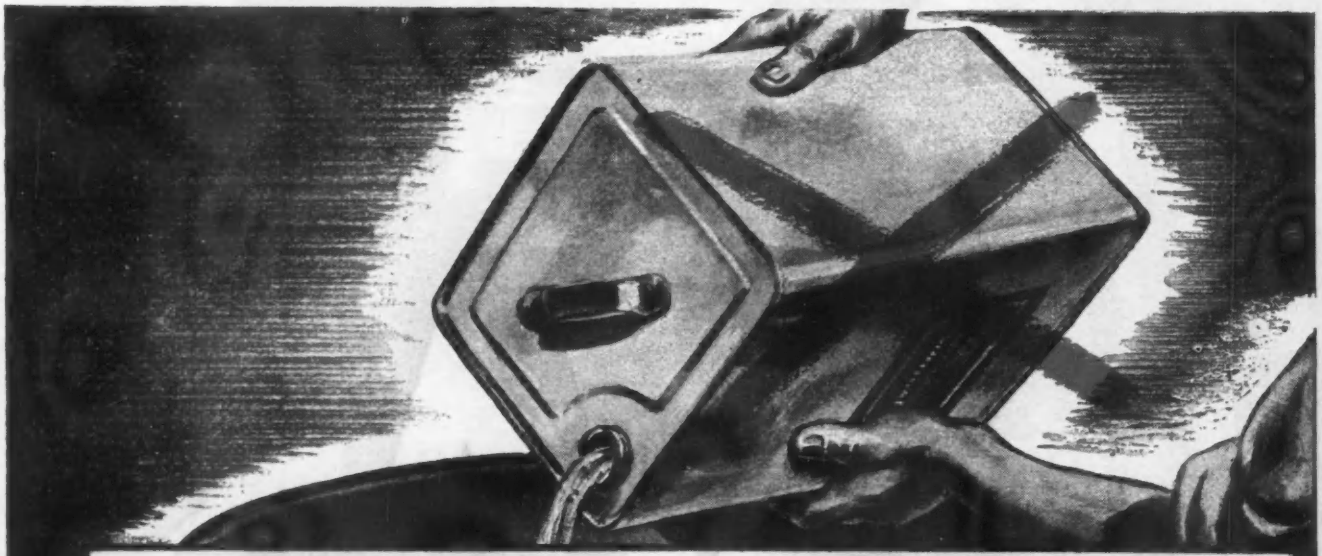
We can make hydraulic units complete from casting to smallest machined part.

We employ only the most advanced production methods and our test equipment will meet the latest hydraulic testing specifications.

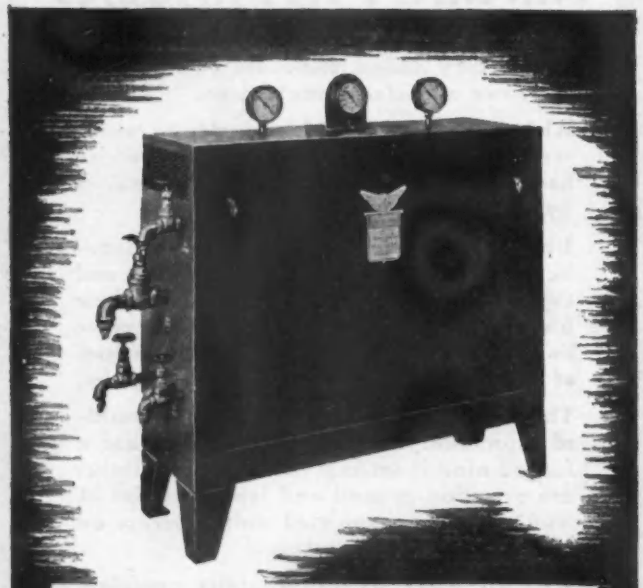
A VARD-built hydraulic unit will meet the specifications.

VARD INC. • PASADENA 8, CALIF.

NO THINNERS !



ELIMINATES THINNERS ENTIRELY (ADJUSTABLE TO GOVERNMENT SPECIFICATIONS)



The compact THERMOTITE* UNIT — perfected in the Sherwin-Williams Aviation Finishes Laboratories — is easy to use, simple to maintain.

...That's

Never before *Thermotite have aircraft dopes been applied with such revolutionary speed, efficiency, and economy!**

Never before *Thermotite have elevated temperatures been used in doping with such *complete* and *lasting* success!**

Thermotite* Unit
***Plus* Thermotite* Products**

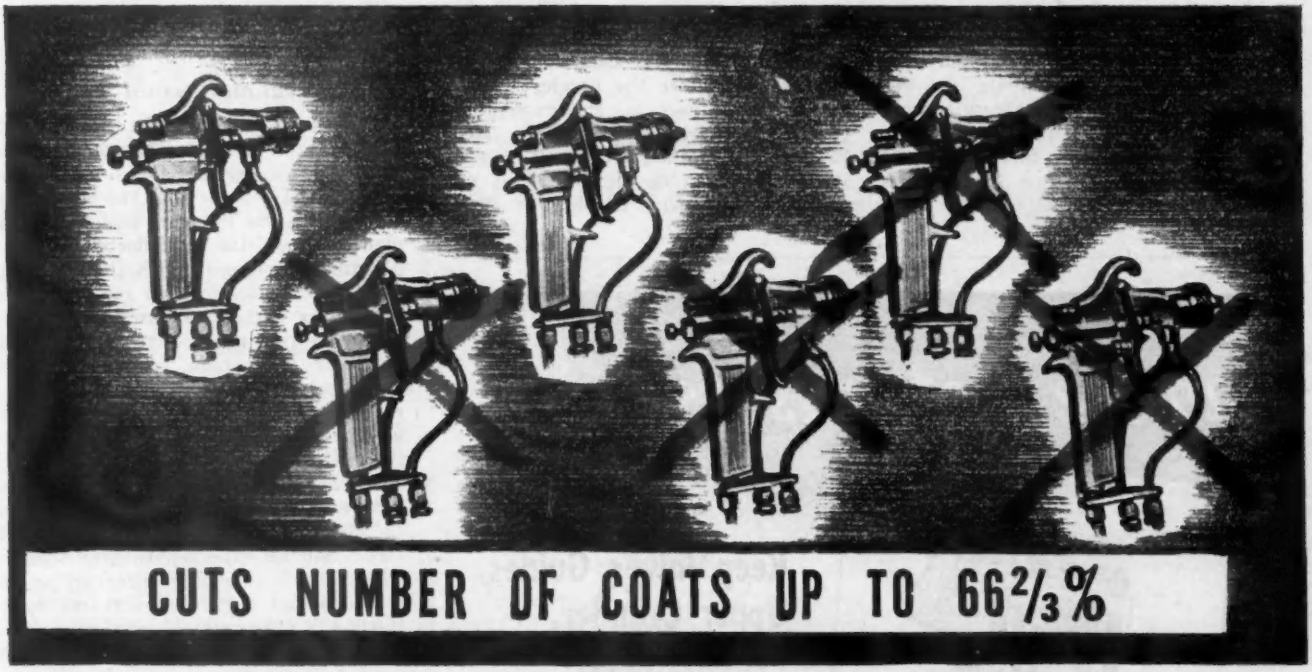
Thermotite* **is a revolutionary new *process*... not just a product or equipment for its application. *Thermotite**** **involves a new kind of application unit perfected by The Sherwin-Williams Co. *Thermotite****, **too, makes use of improved dopes, specially formu-**

**Thermotite and P•D•F—Trade-marks Reg. U. S. Pat. Off.*

SHERWIN-WILLIAMS

FOR QUICK ANSWERS TO YOUR WARTIME AERONAUTICAL FINISHING QUESTIONS

FEWER COATS !



THERMOTITE*!

lated in Sherwin-Williams laboratories. Both dopes and unit form the *Thermotite* Process*, a system that—

Saves Materials, Time and Labor!

Using elevated temperatures, *Thermotite** entirely eliminates the use of thinners. It substitutes *controlled heat* for these critical materials.

The use of *Thermotite** with Sherwin-Williams *P*D*F** (Pre-Doped Fabric) reduces finishing operations as much as 66⅔%. Hence, the *Thermotite* System* saves *time*, saves *labor*, saves *thinner* and thus increases production efficiency. *Thermotite** is the *modern* process for finishing modern aircraft.

Send for Details, List of Users

You just cannot afford not to know the whole story about this revolutionary *Thermotite* Process*. Get in touch with any Sherwin-Williams Aviation Finishes technical representative located near you.

AVIATION FINISHES

WRITE, WIRE, OR PHONE THE SHERWIN-WILLIAMS COMPANY, CLEVELAND 1, OHIO

Recent Research in Poppet Valve Train Design

(*Continued from page* 22)

the nose radius is reduced the stress increases for a given spring load, and the spring load requirements also increase. Fig. 4 shows the stress change for a given cam as the nose radius changes. Field results have indicated that most tappet and cam failures result from high stresses on the nose. The stress at maximum acceleration is usually low; failure occurs on the nose because the lower the acceleration the higher the stress on the nose for a given lift. By adapting the Hertz Equation, a method of determining the stress has been developed. This consists of calculating the highest stress over the area of contact, the area being determined from the modulus of elasticity and contour of the contacting parts under a given load. Charts have been developed which provide a rapid means of determining stresses. See Figs. 5 and 6. These vary with different material combinations and face contour.

Theoretical and Actual Stresses

Obviously, the flat face tappet would always show a lower theoretical stress than the spherical faces. However, Figs. 7 and 8 show that the theoretical stress with the flat face and the actual stress differs due to deflection or misalignment, whereas with the spherical face the stresses are the same with deflection as without, assuming of course that the full contact remains on the face of the cam. Therefore, the spherical face is more reliable and test results are duplicated in production with more certainty; also a higher theoretical stress can be used with the spherical face. Field results indicate that a flat face operated in excess of 125,000 lb (theoretical) maximum stress can be expected to give trouble, whereas the spherical face can be operated satisfactorily at stresses up to 190,000 lb (theoretical) maximum (cast iron tappet and steel cam combination). Improvement can be shown with any material combination by using a manganese iron phosphate coating (Parco-Lubrite) or an iron oxide coating (Ferrox); the latter can be used successfully only on cast iron because the temperature required in application is high enough to anneal the steel parts.

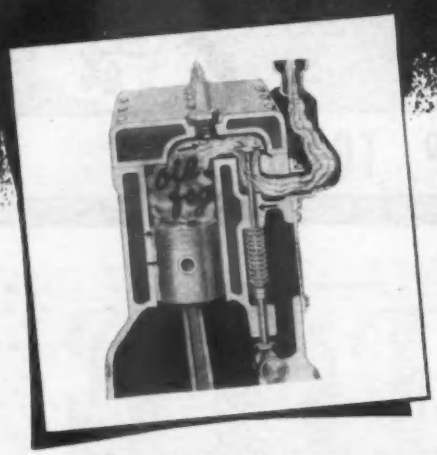
A method for determining the amount of quieting ramp required in cam design is given in Fig. 9. It is obvious that as soon as the valve is lifted from the seat, it will assume an angularity with respect to the axis of the valve guide to the greatest extent that clearance of the valve stem in the guide will permit. The valve will move up in this cocked position and return in the same position, sliding over to line up with the seat after contacting the seat on one side. Thus if the valve contacts the seat at a point high enough on the flank of the cam, velocity can become such as to cause a dishing of the valve by means of a peening action. If this is taken into account in cam design, the ramp on the closing side can be made greater than the opening side and this condition alleviated.

Rocker Arms and Valves

Rocker arms should be designed for the greatest rigidity, with a minimum of weight. Since little side loading is imposed on rocker arms, the greatest section of material should be in the plane at right angle to the axis of the bearing.

The geometry of the rocker arm, with respect to valve movement, is an important item. The movement should be

advise motor users:



Keep Valves, Guides, Upper Cylinder, Pistons, Rings

Oiled thru Carburetor

by treating your gasoline with

LUBRI-GAS

there's NOTHING else like it!

No mechanical system has ever been invented that assures constant, adequate lubrication of valves, guides, upper cylinder, pistons, rings. That is why sticky valves, burned and pitted valve seats, worn rings, and carbon and gum accumulations in upper cylinder are usually the first symptoms of motor trouble. Lubri-Gas Laboratories have developed an exclusive method of chemically processing 40 SAE lubricating oil, so that it enters the combustion chamber, through the carburetor, as an oil fog, and coats all upper cylinder parts with a film of clean oil. The results of this better lubrication are more power, more mileage per gallon, more pep, less wear and repair, freedom from carbon and gum and prevention of overheating and oil pumping. Now when it is so important to keep equipment in operation and out of the repair shop, LUBRI-GAS is indeed a God-send!

Send for Free Lubri-Gas File. Contains complete information about this modern motor fuel treatment.

TRADEMARK

LUBRI-GAS 221 No. LaSalle St. Chicago 1, Ill.

Cleans and Lubricates as It Powers the Motor

"Put it on the Blanchard"

...GET THESE ADVANTAGES

Production ✓
Adaptability ✓
Fixture Saving
Operation Saving
Material Saving
Fine Finish
Flatness
Close Limits

Grinding Cylinder Barrels

These 7½" diameter cylinder barrels are held on the chuck of a No. 18 Blanchard Surface Grinder and supported in a fixture.

The material is nitroloy steel and $^{7}/_{16}$" of stock is removed to limits of .25". Twelve cylinders, 24 surfaces, are ground per hour.

This job shows the ability of the Blanchard Grinder to remove, rapidly and economically, large amounts of hard metal.

Send for your free copy of "Work Done on the Blanchard." This book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.

No. 18 BLANCHARD SURFACE GRINDER

BLANCHARD

The BLANCHARD MACHINE COMPANY
64 STATE STREET, CAMBRIDGE 39, MASS., U. S. A.

FOR HIGHER THERMAL EXPANSION
Use CHACE Manganese ALLOY No. 772

THE temperature coefficient of expansion of Chace Manganese Alloy No. 772 is twice as great as that of ordinary steel . . . considerably higher than aluminum, particularly at elevated temperatures . . . and far beyond that of any other strong alloy. Its expansion rate is independent of thermal treatment, and is not altered by cooling to -100° F. Thus it makes possible unusual differential expansion designs.

Chace Manganese Alloy No. 772 affords an unusual combination of useful engineering properties. It has an electrical resistivity about 60% higher than most resistance alloys in common use . . . a thermal conductivity only about 2% the value of copper . . . a vibration damping constant about 25 times greater than steel. It can be machined, stamped, drawn, extruded, and welded to itself or other metals.

AVAILABLE IN
STRIPS SHEETS RODS AND SPECIAL SHAPES

Complete engineering and research facilities available . . . Bulletin No. A-942, giving detailed information regarding Chace Manganese Alloy No. 772, sent on request.

W.M. CHACE CO.
Manufacturers of
Thermostatic Bimetals and Special Alloys
1610 BEARD AVE • DETROIT 9, MICH.

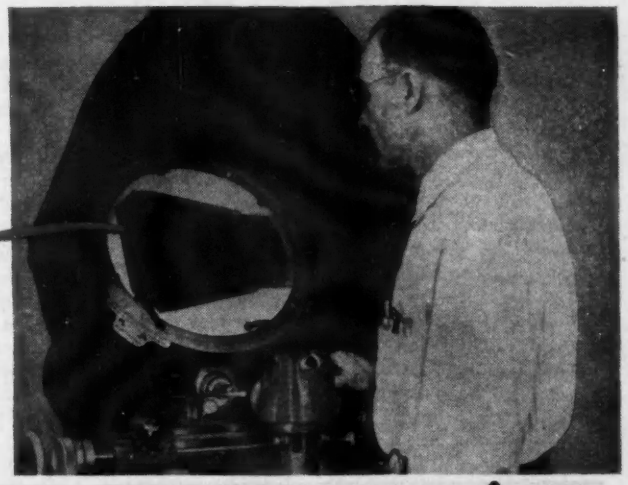
related to load in such a way that the greatest amount of slippage occurs under the lightest loads, and minimum slippage takes place during acceleration. Such an arrangement will reduce the side load on the valve and tend to prevent excessive wear of the valve stem in the guide. Thus in the case of mushroom cams, in order to provide minimum slippage during acceleration and maximum during deceleration, approximately one-third of the valve lift should occur above and two-thirds below the center-line. This general principle applies to roller as well as the ordinary shoe contact.

Sodium cooled valves which are an essential in high output aircraft engines are coming into more common use in other engines because of the reduction in down-time for over-haul. Sodium cooled valves have been given little consideration for Diesel engines, mainly because additional cooling has not been required. When a valve stem is drilled, to reduce its weight, there is a loss in cooling capacity, particularly with respect to the heat carried down the stem of the valve. This loss can be considerably more than offset by partially filling the valve stem with sodium. Weight of valves has been reduced 24 per cent by this process. This reduction in weight offers a worthwhile advantage to Diesel manufacturers.

Hydraulic Valve Lifters

The advantages of hydraulic valve lifters becomes more apparent as we improve our understanding of the problems involved in the valve train. Hydraulic valve lifters increase the life of the valve train and thus increase the time between overhauls. This is accomplished by relieving the shock loading reducing false motion, thus providing assurance against breakage of valve train parts. In addition to this, freedom from adjustment, increased flexibility in cam design and quietness is provided.

Where hydraulic valve lifters are used, the timing remains constant throughout the entire temperature range of the engine, and is unaffected by wear of any of the reciprocating parts. This is a very great advantage in most air-cooled engines or any engine in which tappet clearance increases as the temperature rises. It obviates the necessity of compromising in the cam design for starting and idling. It is advantageous in any engine in that it eliminates the necessity for using a long ramp in order to lift and seat the valve at low velocity throughout the temperature range. The use of long ramps imposes an extra amount of punishment on the valve, an example of which is shown in Fig. 10. This chart was taken from data obtained on an ordinary automotive engine, and represents a radial timing diagram upon which is superimposed the cylinder pressure curve in heavy line. The manufacturer gives D as the timing point for the opening of the ex-



80% time saved...

INSPECTING HIGH PRECISION COLLET HOLDERS

The manufacturer of these collet holders reports "a time saving of eighty percent (80%) over the method formerly used - - - ", when a Jones & Lamson Pedestal Optical Comparator was installed. The angles are held to limits of ± 15 minutes of arc, and the straight diameter to ± .001".

Through a highly precise lens system, a magnified shadow of the part is projected upon the screen of the Comparator and compared with a master outline drawn upon the glass. It's as simple as that, and the results are accurate beyond a shadow of a doubt.

Form tools, gages and other products with complex or multiform contours can be checked and measured in all dimensions by means of the standard measuring attachments of Jones & Lamson Optical Comparators.

For the method best suited to your own needs, consult a Jones & Lamson inspection engineer. There is one near you, and he is backed by an organization with over 20 years experience in the optical inspection field.

This book "Beyond a Shadow of a Doubt" will tell you more about our Optical Comparators and what they are doing.

DID YOU KNOW...
THAT MOTION PICTURE FILM, DIES FOR PUNCHING THE FILM AND NUMEROUS MOVIE CAMERA PARTS ARE INSPECTED WITH JONES & LAMSON OPTICAL COMPARATORS – TO GIVE YOU BETTER MOVING PICTURES AND BETTER PROJECTION.

JONES & LAMSON
MACHINE COMPANY
Springfield, Vermont, U.S.A.

Manufacturer of: Universal Turret Lathes • Fay Automatic Lathes • Automatic Double-End Milling and Centering Machines • Automatic Thread Grinders • Optical Comparators • Automatic Opening Threading Dies and Chasers.

haust valve, but allowable clearance variations bring the cracking point of the exhaust valve to C. At full throttle, maximum power, the clearance is reduced to bring the cracking point of the exhaust valve to B. In order to accelerate valve destruction tests, for which this engine is used, a camshaft was designed with a special ramp which brought the cracking point of the exhaust valve to A. Moving the cracking point from B to A doubled the destruction of the valve and cut the test about in half.

Fig. 11 shows three ramps; the center one is the conventional ramp used on this engine in production; the upper one is the special ramp for valve destruction; and the lower one is the one which may be used with hydraulic lifters.

In working with engines in which the tappet clearance increases as the temperature rises, cases have been found where the tappet clearance was adjusted hot, and the valves were damaged in starting cold before reaching normal clearance. Likewise, with clearances adjusted cold, they opened up a sufficient amount when the engine reached running temperature to move the closing point away from the ramp of the cam and close the valve at excessive velocity, causing breakage. Hydraulic lifters in such engines have corrected both these types of trouble.

Clearance Problem

In considering engines in which valve clearance tends to decrease as temperature rises, one of the common problems is to allow sufficient clearance to take care of extreme operating conditions. It is obvious, since a considerable percentage of the cooling of a valve is accomplished by transferring the heat from the seat of the valve to the block, that, when the valve is held open by some temporary cause, the temperature of the valve rises. Because of the resulting expansion in the valve itself, this rise in temperature often may be sufficient to cause the valve to remain in the open position even when the initial cause for holding the valve open is removed. Thus, it may not seat again until the load has been reduced to permit sufficient cooling.

The use of hydraulic valve lifters is an assurance that valves cannot hold open under any operating conditions except when this condition is caused by stem deposits or broken springs. Even then, when the initial cause is removed, the valve will close quickly and, if too much damage has not already been done, will continue to give satisfactory service.

An initial adjustment is all that is necessary for hydraulic lifters, and this adjustment is unnecessary when the parts can be held to limits that will put the units within their operating range. This range is usually 0.125 in. but, in some cases, has been made as much as 0.937 in. and as little as 0.062 in., depending upon the individual requirements.

Possible Locations of Hydraulic Unit

The hydraulic unit may be located in the tappet, in the upper or lower end of the pushrod, or in the rocker arm. When installed in the rocker arm, the unit is usually placed on the pushrod side but, in a few cases, it has been applied to the valve side. In addition to these applications, in at least one experimental case, the unit was located at the fulcrum point of the rocker arm.

Fig. 12 shows a type of application with the unit at the top of the pushrod, which has been tried experimentally. While it has operated successfully in several engines, there has been no occasion to use the application in production.

Fig. 13 shows a production application in a light air cooled aircraft engine. A 0.437 in. unit is installed in the tappet, the pushrod socket being integral with the plunger. Fig. 14 is a view of a radial-engine valve train with the hydraulic unit installed in the tappet.

Choose the Characteristics You Need
• RESISTANCE TO AIR • LIGHT • PETROLEUM • AGE, ETC.
• ELASTICITY • RIGIDITY • PLASTICITY • RESILIENCE, ETC.
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THE Right Synthetic!
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Incorporating properties found in natural rubber, and some that are not, Acadia can supply the proper synthetic to meet the job requirements.
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LARGEST INDEPENDENT MANUFACTURERS AND CUTTERS OF FELT

THE OUNCE THAT GREW

AN OUNCE is just an ounce, you say. But see what happens when it "runs wild" in a piece of high-speed machinery—a flywheel, for example.

As the wheel gathers speed, a single inch-ounce* of unbalance grows and Grows and GROWS till, at 5,000 R.P.M., it is multiplied over 800 times! No mere ounce, but *44.3 pounds* of additional load must be carried by the bearings, which seeks to tear the wheel from its moorings on each revolution.

Fortunately, this destructive vibration can be checked —quickly and at low cost—with GISHOLT DYNETRIC BALANCING MACHINES†. So simple has the process become that these unbalanced forces are now *located, measured* and *corrected* in a matter of seconds. And with a degree of accuracy that is not approached by any other means.

With vibration so easy to cure, why take chances? Gisholt engineers are ready to help you solve your particular vibration and balancing problems.

**An inch-ounce is the centrifugal effect produced by a one ounce weight one inch from axis of rotation.*
†A development of Westinghouse Research Laboratories.

DYNETRIC BALANCING MACHINES are improving the performance of many vital war products such as armatures, crankshafts, aircraft propellers, supercharger impellers, etc. Write for complete information on Dynetric Balancing.

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Look Ahead . . . Keep Ahead . . .
With Gisholt Improvements

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES • SPECIAL MACHINES

German Welding

(*Continued from page* 37)

welding head can be adapted to the shape of the job and the required welding power, i.e. the diameter of the carbon electrode. It is possible usually to weld the joint in place. In special cases the joint arrangement previously used for soldering must be modified for use of welding.

It is stated that all heavy metals and their alloys are weldable; best of all is copper with copper. Aluminum alone requires special electrodes. Zinc alloys are weldable only if well protected from the air. Zinc-zinc welds are made in an iron sleeve. Aluminum-copper welds require an excess of aluminum. Galvanizing does not affect weldability, except in the case of the destruction of the coating by the welding heat. Thus, tin or zinc coatings on iron are unsuitable. Brass is most weldable in the bright condition, and galvanic coatings are not disturbing. Non-conducting coatings such as anodic oxides or phosphatic films should be removed from the joint facings before welding.

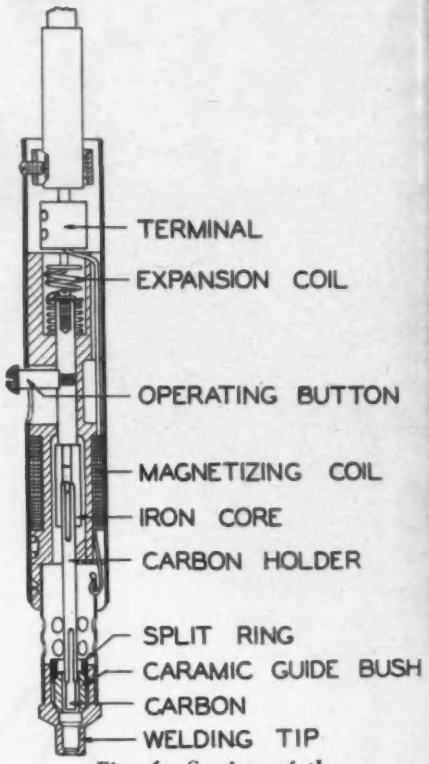


Fig. 4—Section of the "welding pencil"

Now—Air Operated Collet Chuck Relieves Second Operation Work on Screw Machines

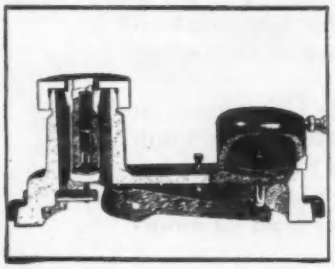
Work formerly requiring automatic or hand screw machines can now be done at much less cost through the combination of this new air chuck and any drill press. The Redmer Air Chuck is a collet air chuck using standard Brown & Sharpe type screw machine collets. The collet remains stationary, the opening and closing controlled by a sleeve action.

By using a collet as the chucking means, slight variations in the diameter of the work as frequently experienced with automatic and hand screw machine products can be permitted without sacrificing accuracy or concentricity. Thus accomplishing an important saving in time and cost.

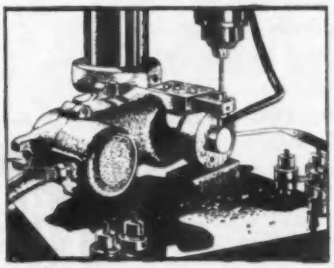
The air chuck is an ideal tool for holding parts for drilling, milling, slotting, burring, chamfering, boring, counterboring, tapping, threading, reaming and other work where the machine operation should be concentric with the chucking surface. It is adaptable to many different jobs merely by changing collet and stop. This results in saving of valuable production metals and materials. The chuck will take any type work whether round, hex, square or rectangular, and permits full efficiency of the operator, as it is operated by a foot operated valve thus leaving hands free to load and unload—reducing fatigue and cutting unproductive time to a minimum.

Wrigley's Spearmint Gum, too, is a help on the job. For chewing gum helps relieve dry throat, and helps ease fatigue brought on by the strain of work. And at the same time you are chewing and getting the benefits of swell tasting Wrigley's Spearmint, both hands are free and you need not take a "time out." The Army and Navy have recognized these benefits and are now shipping overseas *only,* all of the limited production of Wrigley's Spearmint. When Wrigley's Spearmint can again be produced in sufficient quantity for all, the valuable benefits of Wrigley's Spearmint Gum now being proven on the battlefield will apply to industry here at home.

You can get complete information from Redmer Air Devices Corp., 601 West Washington Blvd., Chicago 6, Ill.



An air operated collet holding fixture for precision chucking or machine tools



Chuck can be mounted on angle for angle milling job

Y-151

Spitfire XIV

(*Continued from page* 35)

TION INDUSTRIES. The plane was designed at the Vickers Armstrong Supermarine plant.

Alternative armaments consist of four 20-mm cannon, or two 20-mm cannon and two 0.5 in. machine guns, or two 20-mm cannon and four 0.303 in. machine guns. Used as a fighter-bomber the Spitfire XIV can carry either a 250 or 500 lb bomb underneath the fuselage. Alternatively it can carry a drop tank instead of a bomb. Another feature is a retractable tail wheel.

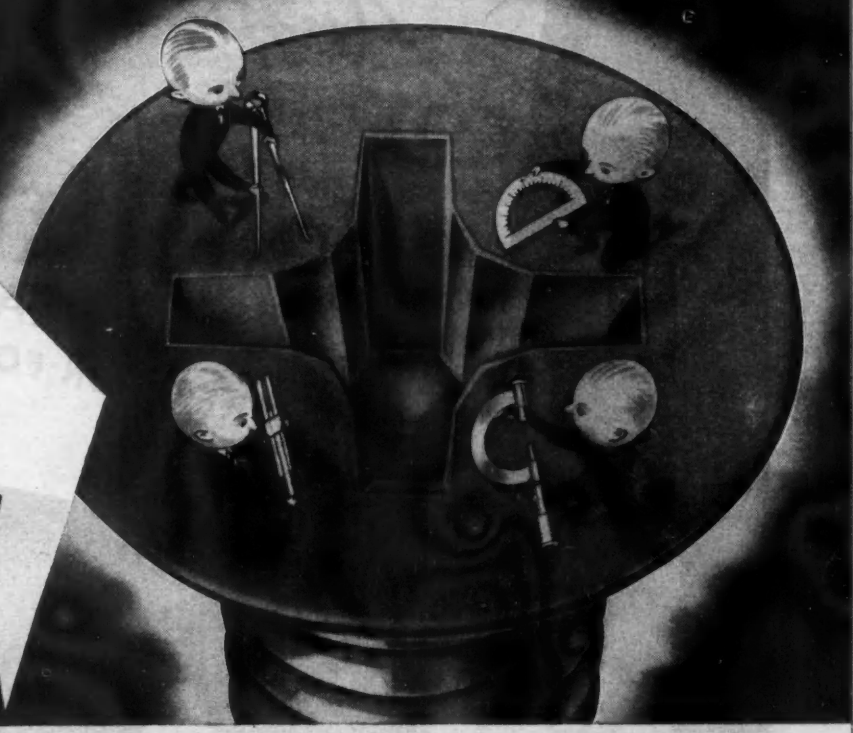
Though maximum performance of the Spitfire XIV is not revealed, it is stated that the new model is faster than any other Spitfire in service. An earlier model Spitfire—the Mark IX—had an admitted speed of over 400 mph. Following are the dimensions of the new aircraft:

Span	36 ft. 10 in.
Length	32 ft. 7¾ in.
Height	11 ft. 1½ in. (tail up, one blade vertical)
Wing area	242 sq. ft.
Weight	about 8000 lb.

Advertising Note

L. A. Clark, general manager of Florez, Phillips and Clark, Detroit marketing agency, recently announced appointment of John T. Nevill, Detroit newspaper, magazine and advertising writer, to the Florez, Phillips and Clark staff.

IT TAKES A LOT OF *know-how* TO DESIGN AN *Engineered* SCREW RECESS



. . . . . AND THE PHILLIPS RECESS HAS WHAT IT TAKES!

TAKE A LOOK at the center corners of the Phillips Recess above – and get a picture of some real screw engineering!

THESE CORNERS *aren't square!* They're rounded into a series of 16 flat planes. It's these flat planes that *hold* drivers in the Phillips Recess so well.

THEN NOTICE how the 4 wings and the 16 flat planes are angled. It's the scientifically determined degree of these angles that eliminates fumbling starts . . . makes it possible to use full turning power . . . makes it hard to burr Phillips Head Screws, and reduces wear on Phillips Bits and Drivers.

FOR ANOTHER INSTANCE of Phillips engineering ingenuity, note the depth of the Phillips Recess. It's not too deep . . . not too shallow. It's just the right depth to give Phillips Recessed Head Screws the strength to stand up under the heaviest driving pressures. Just the right depth to give maximum turning power with a minimum of effort . . . to keep drivers in proper alignment with screws!

COST LESS! Switch to screws with the scientifically engineered Phillips Recess — they cost less because they help you produce more! Available in any head style, type, or size.

PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS · MACHINE SCREWS · SELF-TAPPING SCREWS · STOVE BOLTS

TO MAKE WARTIME QUOTAS AND PEACETIME PROFITS

Faster Starting: Driver point automatically centers in the Phillips Recess . . . fits snugly. Fumbling, wobbly starts, slant driving are eliminated. Work is made trouble-proof for green hands.

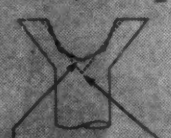
Faster Driving: Spiral and power driving are made practical. Driver won't slip from recess to spoil material or injure worker. (Average time saving is 50%.)

Easier Driving: Turning power is fully utilized. Workers maintain speed without tiring.

Better Fastening: Screws are set-up uniformly tight, without burring or breaking of screw heads. The job is stronger, and the ornamental recess adds to appearance.

IDENTIFY IT!

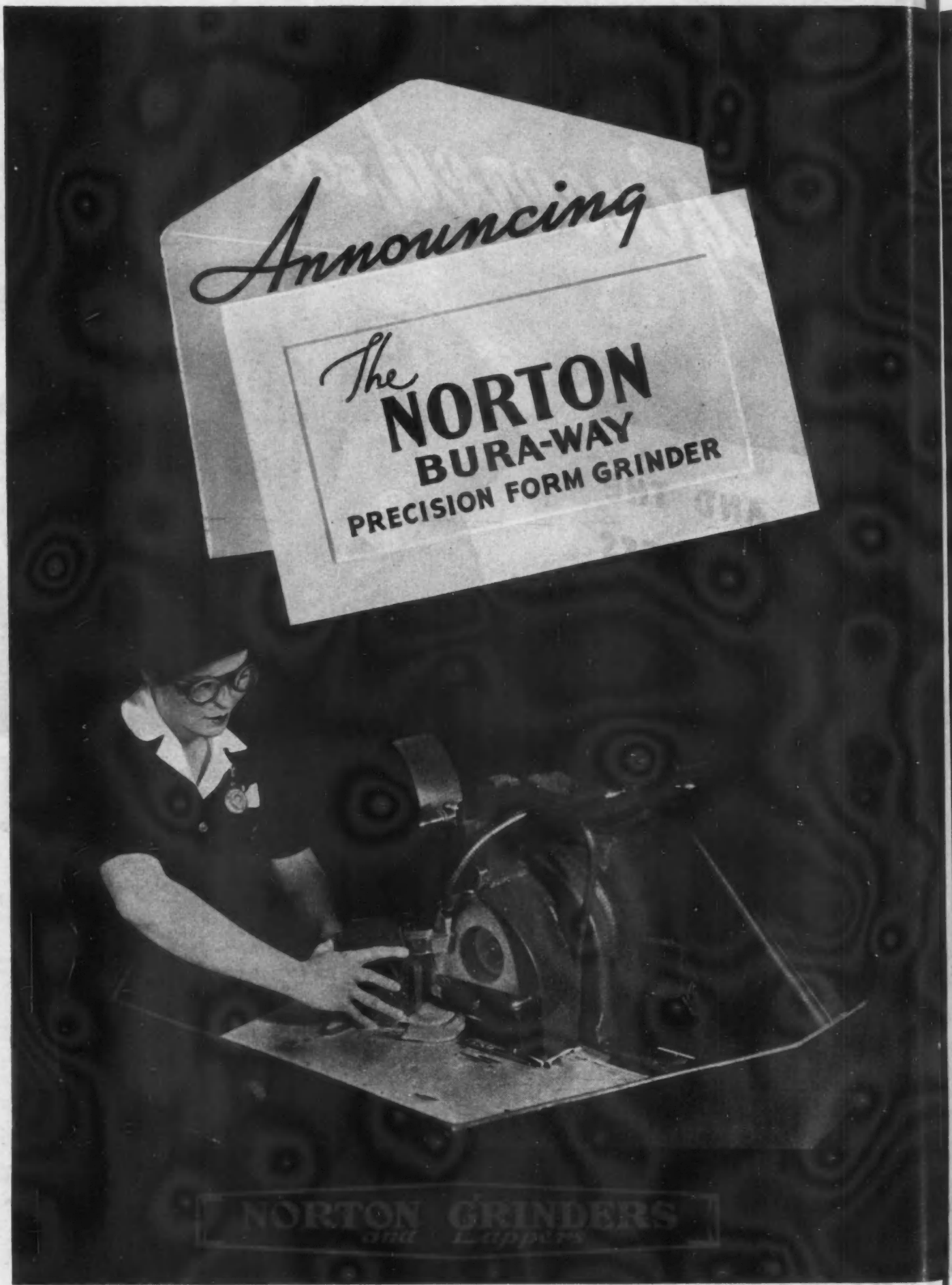
Center corners of Phillips Recess are rounded . . . NOT square.



Bottom of Phillips Recess is nearly flat . . . NOT tapered to a sharp point.

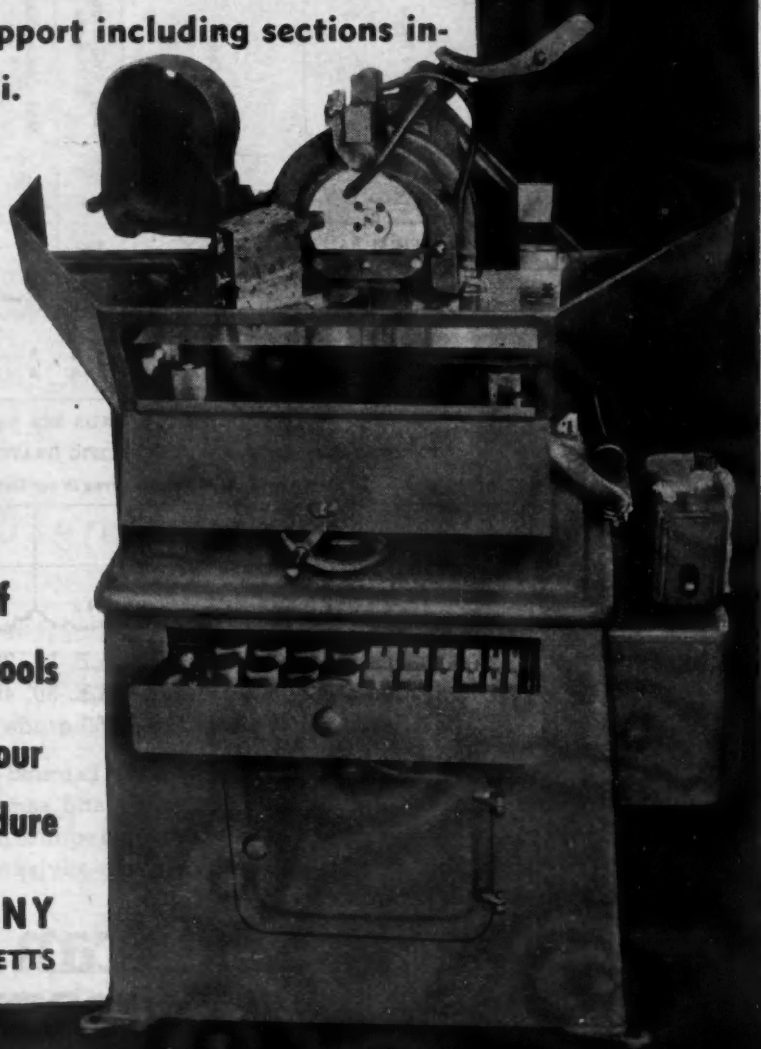
24 SOURCES

American Screw Co., Providence, R. I.
Atlantic Screw Works, Hartford, Conn.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
General Screw Mfg. Co., Chicago, Ill.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
Manufacturers Screw Products, Chicago, Ill.
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoli Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Wolverine Bolt Co., Detroit, Mich.


Announcing
The NORTON
BURA-WAY
PRECISION FORM GRINDER
NORTON GRINDERS

The New Principle IN TOOL GRINDING

The Norton Bura-way Grinder combines new principles in the design of cutting tools in a machine which generates, reproduces and maintains relief angles constant as measured in the direction of feed. This provides the entire cutting edge of a tool with a uniform, adequate support including sections involving curves and radii.



The NORTON Bura-way

Will Lengthen Tool Life

Will Increase Production

Will Reduce Inventory of Production Tools

Is Readily Adapted to your Tool Room Procedure

NORTON COMPANY
WORCESTER 6, MASSACHUSETTS

SPECIFY AMERICAN FELT CO. STANDARDS FOR S.A.E. FELTS

1. To Save Time In Specifying
2. To Insure Maximum Performance
3. To Assure Uniformity On Re-Orders

Design-engineers and specification men find American Felt Standards of material aid in the rapid selection of the *correct* FELT for every application. The following data (on 3 S.A.E. grades) indicates the comprehensiveness of the specifications that have been developed.

TABLE 1—CHEMICAL AND PHYSICAL PROPERTIES

WOOL CONTENT ON THE "FIBRE BASIS" IS CALCULATED AFTER REMOVAL OF ALL NON FIBROUS MATERIALS, WHEREAS THE WOOL CONTENT ON THE "CHEMICAL BASIS" IS FIGURED AS A PERCENTAGE OF THE TOTAL MANUFACTURED WEIGHT OF THE FELT.

S.A.E. Specification Number	American Felt Co. Standard S.A.E. Felt Qualities	Trade Name	Color	Min. Wool Content Fibre Basis	Max. Cotton Content Fibre Basis	Min. Wool Content Chemical Basis	Max. Carbon Tet.	Max. Water Soluble	Max. Ash	Max. Non-Fibrous Impurities	Min. Break Strength Pounds Per Sq. In. of Cross Section	Min. Splitting Resistance
				%	%	%	%	%	%	%		
F- 1	7544	BACK CHECK	WHITE	100	....	95	2.5	2.5	1.0	3.0	500	33
F- 5	51018	EXTRA FIRM PAD	WHITE	100	....	95	2.5	2.5	1.0	3.0	400	18
F-10	51018	FIRM PAD	WHITE	100	....	95	2.5	2.5	1.0	3.0	225	8

TABLE 2—WEIGHT—THICKNESS—DENSITY—SPECIFICATIONS AND TOLERANCES

S.A.E. Specification Number	WEIGHT OF FELT, POUNDS PER SQUARE YARD PERCENTAGE DENSITY = 100 x SPECIFIC GRAVITY (S. G. WATER = 1.00) (Based upon the expression given in our Data Sheet #1)							Density Tolerance
	THICKNESS TOLERANCE	1/8" .112"—.137"	3/16" .173"—.201"	1/4" .235"—.265"	5/16" .296"—.329"	3/8" .358"—.392"	1/2" .480"—.520"	
F- 1	Lb./Sq. Yd.	2.0	3.0	4.0	5.0	6.0	8.0	34.18
	TOLERANCE	1.9—2.1	2.85—3.15	3.8—4.2	4.75—5.25	5.7—6.3	7.6—8.4	30.76—37.60

Use S.A.E. F-1 Felt for S.A.E. 10, 20 or 30 grade oil.
Use S.A.E. F-5 Felt for S.A.E. 30, 40 or 50 grade oil.
Use S.A.E. F-10 Felt for S.A.E. 50 grade oil and light greases.

Technical information on all S.A.E. Felts is found in Data Sheet #5, "S.A.E. Felt—American Felt Standards." Your copy and sample card will be mailed, upon request—also any samples you may require for testing or experiment. Our Product Engineers are always ready to advise on any Felt application.

American Felt Company

TRADE MARK

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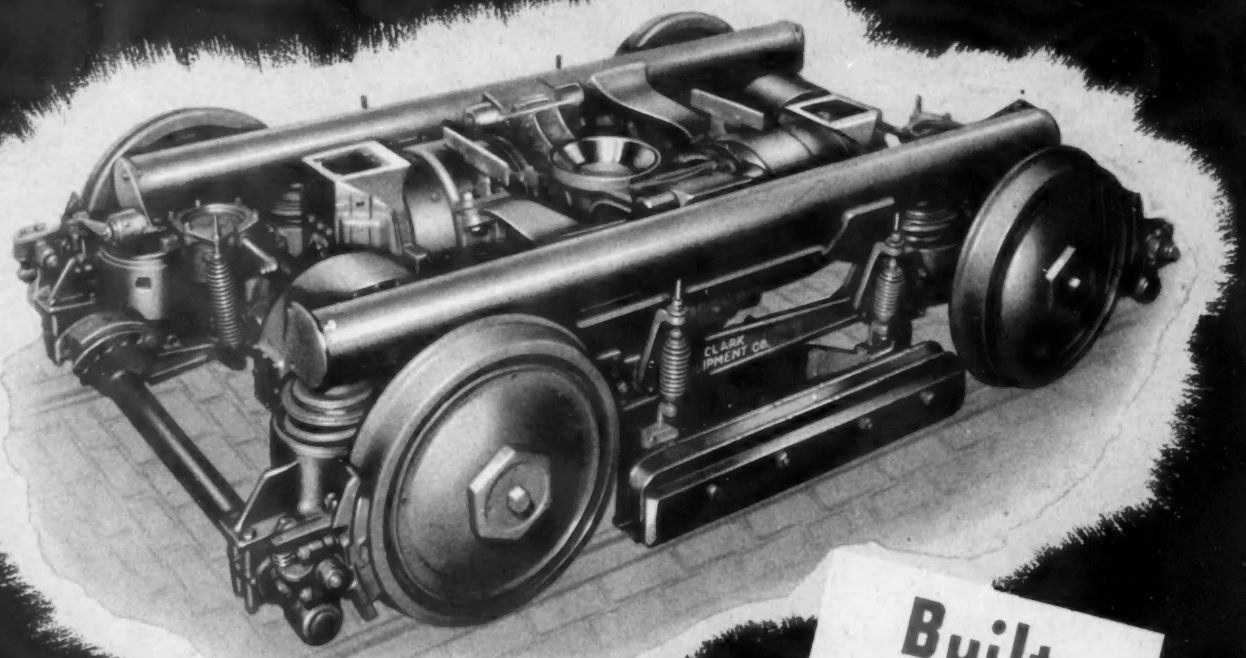
Sales Offices at New York, Boston, Chicago, Detroit, Philadelphia, Cleveland, St. Louis, San Francisco, Dallas, Seattle, Los Angeles

PRODUCERS OF FINEST QUALITY FELT PARTS FOR OIL RETAINERS, WICKS, GREASE RETAINERS; DUST EXCLUDERS, GASKETS, PACKING, VIBRATION ISOLATION, INSULATION AND SOUND ABSORPTION FELTS

CLARK *Silent* STREET RAILWAY TRUCK



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RUBBER CUSHIONED THROUGHOUT THE TRUCK AND IN THE WHEELS—A SILENT SMOOTH-RIDING CAR . . . HYPOID GEARING ELIMINATES THE GEAR NOISE COMMON TO CARS OF CONVENTIONAL TYPE . . . PRECISION BUILT, WITH FULL INTERCHANGEABILITY OF ALL PARTS . . . NOW IN USE UNDER MORE THAN 2400 NEW STREAMLINED CARS OPERATING IN 16 LEADING CITIES OF THE UNITED STATES AND CANADA.

Another PRODUCT of CLARK EQUIPMENT COMPANY

SEE PAGE FOR MORE DATA

THIS CLARK TRUCK REVOLUTIONIZING STREET RAILWAY TRANSPORTATION

Only from the people who ride on them and from the men who operate them can a true measure be had of the brilliant success won by Clark Silent Electric Railway Trucks. A social success—for people prefer the quiet smoothness of Clark-equipped cars; and a business success, for their advantages are attractively written in bigger revenues and lower costs.

Out of studies made by the electric railway Presidents' Conference Committee came the P.C.C. car—and its remarkable trucks built by Clark; equipped with silent hypoid gearing, with rubber insulated wheels, with all its parts interchangable.

Under more than 2,200 swift streamlined cars in 16 major cities, these trucks tend silently, smoothly to their job—smart modern tributes to patient, painstaking engineering and precision manufacture.

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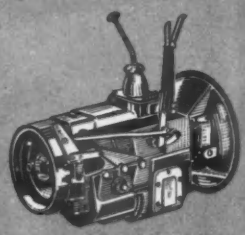
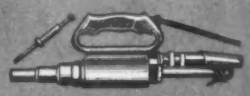
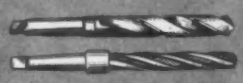

TRANSMISSIONS


BLIND RIVETING PROCESS

AXLE HOUSINGS

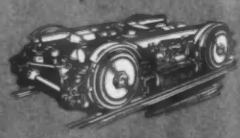
FRONT AND REAR AXLES FOR TRUCKS AND BUSSES

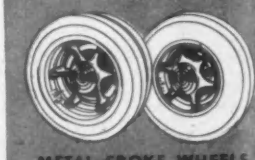

DRILLS AND REAMERS

GEARS AND FORGINGS

ELECTRIC STEEL CASTINGS

INDUSTRIAL TRUCKS AND TRACTORS


RAILWAY CAR TRUCKS

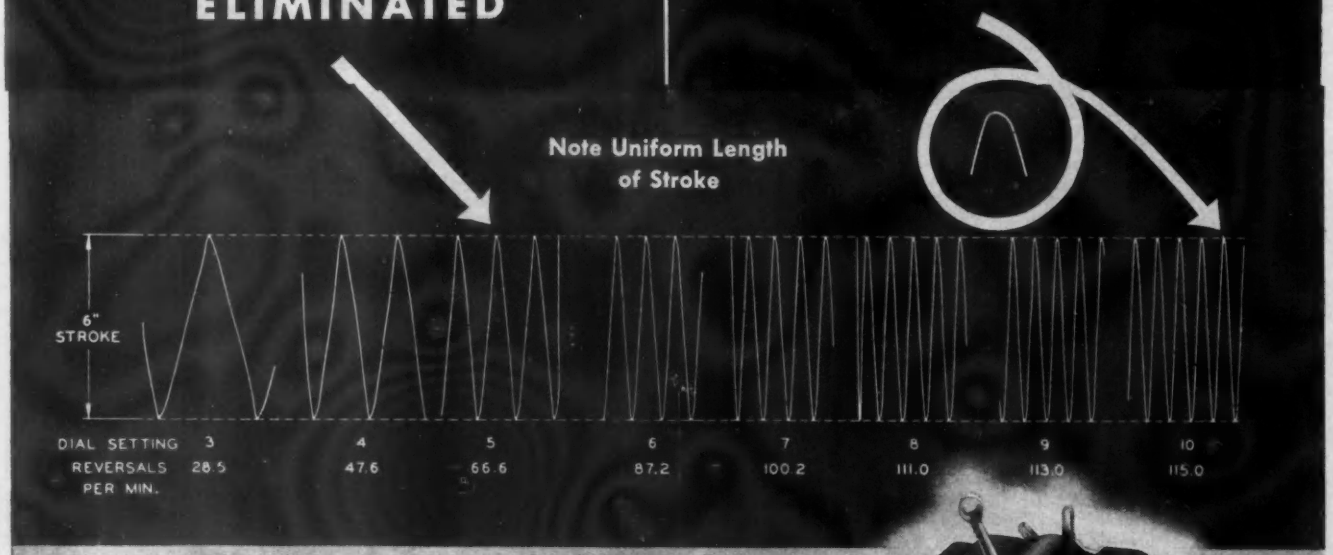

METAL SPOKE WHEELS

CLARK Silent STREET RAILWAY TRUCKS

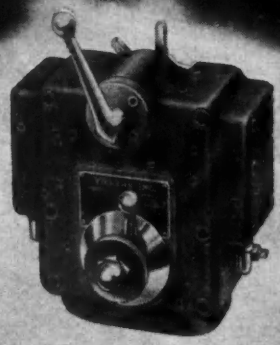
For Machines Requiring Continuous Reciprocating Cycles:

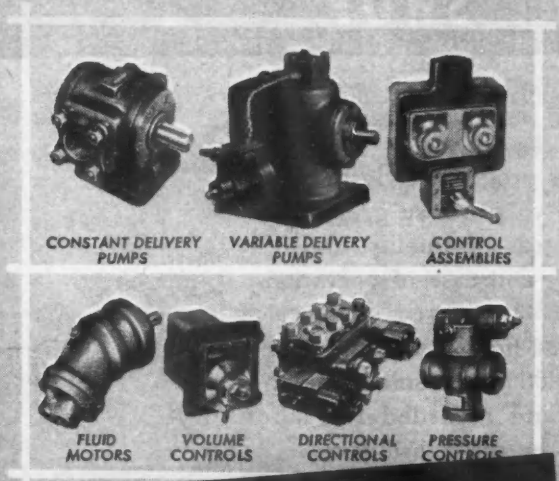
OVERRIDE PRACTICALLY ELIMINATED

SMOOTH REVERSALS AT ALL SPEEDS



VICKERS "RECIPROCATING CYCLE" CONTROL PANELS





Representative of More Than 5,000 Standardized Vickers Units for Every Hydraulic Power and Control Function

This is a complete self-contained control unit for grinding machines, honing machines, or any process requiring a continuous reciprocating cycle.

The curves reproduced above were accurately made by a stylus attached to a reciprocating head and tracing upon a recording mechanism. Note uniform stroke length regardless of large changes in head or table speed. Throughout the test the setting of reversing trip dogs remained unchanged. An integral Vickers Hydrostatic Compensator makes flow rate (and therefore rate of reciprocation) independent of variations in resistance encountered. Similar tests and many installations show that at other speeds, loads and stroke lengths the same smooth reversals and accurate stroke length control are maintained.

Vickers Application Engineers will gladly discuss with you how "hydraulics" can be used to your advantage.

VICKERS *Incorporated*

1428 OAKMAN BLVD. • DETROIT 32, MICHIGAN

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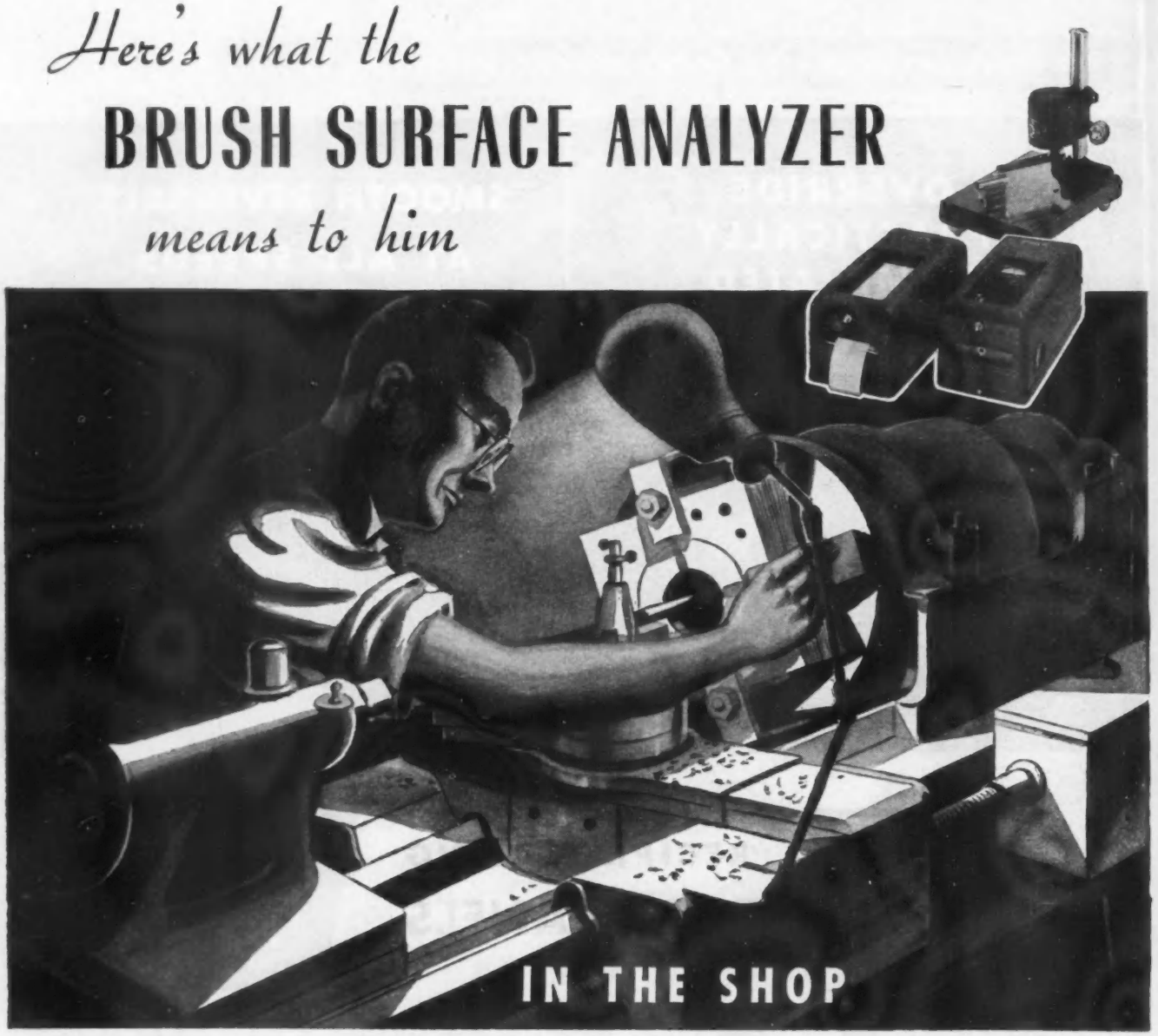
Here's what the

BRUSH SURFACE ANALYZER

means to him



Yes, war has its good points too. War stimulates progress. Industry is called upon to deliver as never before — to produce greater quantities of finer equipment. Higher standards of quality insure our equipment of longer life, dependability and ease of operation. Surface finish is vital to fine quality. The mated surfaces of precision-built parts designed to move at high speeds are but one example of the need for microinch (.000001") smoothness. Such finishes are accurately measured and recorded for laboratory study or production-line inspection by the Brush Surface Analyzer.

Write today for a fully illustrated bulletin on what the Brush Surface Analyzer can do for you.

THE BRUSH DEVELOPMENT COMPANY

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. . IS AVAILABLE FOR TRUCKS AND TRAILERS

Yes, you can again build lightweight aluminum truck and trailer bodies. And metal is available for reconditioning those prewar jobs that have been worked so hard all during the war. W.P.B. now permits the use of aluminum for these important purposes.

The lighter weight of aluminum bodies means that, for equal loadings on power plants, tires and brakes, trucks and trailers carry more weight. These greater payloads result in fewer trips to deliver an equal amount of goods. You save on manpower, reduce operating expenses, and fewer pieces of equipment are required.

The sturdiness of aluminum construction, coupled with the corrosion-resisting ability of aluminum, means less manpower is needed for upkeep. Its fine appearance is a morale and business builder.

Aluminum sheet for siding, special extruded shapes for body work, are in Alcoa's distributors' stockrooms, ready for your requisition. Perhaps you can't get the large size sheets you're accustomed to working with, but take the smaller sheets. Aluminum bolts and rivets are in stock for assembly work.

Send for the new booklet listing the Alcoa Aluminum sheet, shapes and fittings in stock. Then, you can proceed with that design job. Write ALUMINUM COMPANY OF AMERICA, 2110 Gulf Building, Pittsburgh 19, Pennsylvania.

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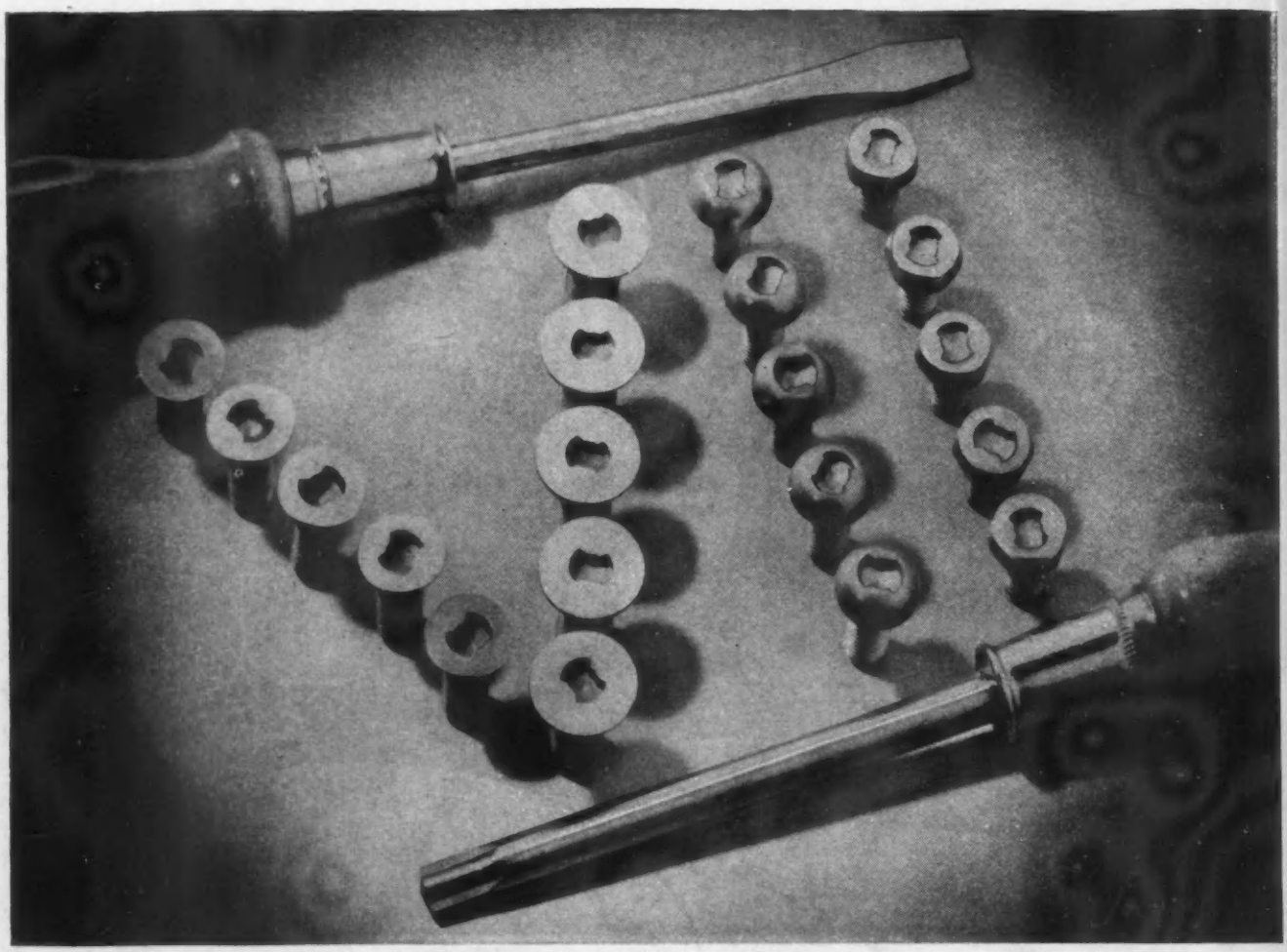


Seven Major Features

have established CLUTCH HEAD as the most modern screw on the market . . . for safer, speedier production and lower final cost.

I The wide roomy Clutch, an easy-to-hit target, inviting operator confidence and speed.

II Center Pivot entry to prevent canting; deep positive engagement for protection against slippage . . . safeguarding manpower and materials.

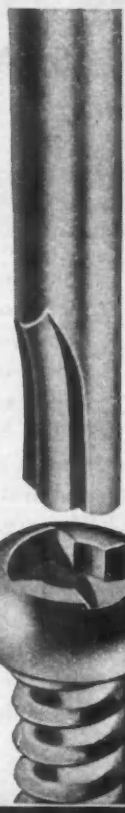
III No end pressure. The straight-walled Clutch matched by straight-sided driver disposes of "ride-out" tendency as set up by "tapered" drive home.

IV CLUTCH HEAD'S exclusive Lock-On unites screw and bit as a unit . . . substituting easy one-handed reaching for fumbling with mechanical fingers.

V The rugged Type "A" Bit delivers a longer uninterrupted spell of service . . . and may be repeatedly reconditioned to original efficiency by a 60-second application of the end surface to a grinding wheel.

VI Simplified field service . . . because CLUTCH HEAD is the only modern screw operative with the ordinary type screwdriver, *or any flat blade*, of proper width.

VII Here again the CLUTCH HEAD Lock-On saves the day. With the Type "A" Bit, rusted-in and frozen-in screws may be withdrawn undamaged and held secure against dropping for re-use.



Because CLUTCH HEAD *is "The Screw That Sells Itself," we invite you to personally examine and test these features. Your request will bring you, BY MAIL, a package assortment of* CLUTCH HEAD *Screws and sample Type "A" Bit; also fully illustrated Brochure.*

CLUTCH HEAD · SCREWS ·

UNITED SCREW AND BOLT CORPORATION

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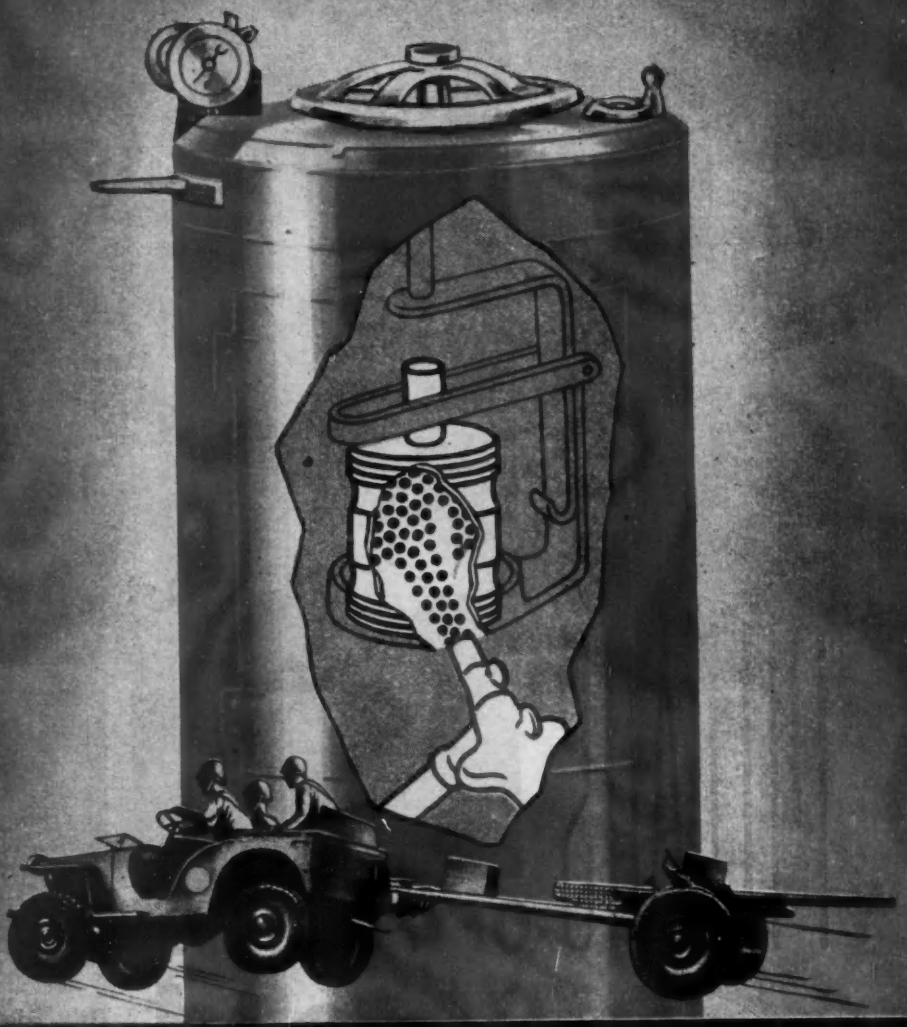
A SHOT IN THE ARM FOR COLLAPSED PISTONS



At Allied echelons all over the world, Koetherizing machines are helping keep vital equipment in the fight. Koetherizing promptly restores collapsed pistons to their original performance. And it is the one quick, easy and *positive* method for doing this needed wartime work.

KOETHERIZING SAVES both the extra cost of new pistons, and the vital metal loss in scrapping old ones.

KOETHERIZING SAVES gasoline and oil that are wasted by collapsed pistons.

KOETHERIZING SAVES precious time . . . increases the value of reduced mechanical staffs.

KOETHERIZING SAVES the war effort that is lost when repairs unduly tie-up vital transportation.

KOETHERIZE EVERY PULLED PISTON

Here's what KOETHERIZING does

Expands pistons accurately to within .001".

Resizes pistons permanently. Koetherized pistons will not collapse again.

Equally effective on cast iron or aluminum pistons.

Does not make pistons weak or brittle.

Does not create piston-boss distortion or disturb piston pin fit.

Does not add weight to the pistons. ★

KOETHERIZE

(PRONOUNCED "KO-THER-EYES")

Over 700 jobbers have Koetherizing . . . Ask for it by name

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AMERICAN HAMMERED PISTON RING DIVISION

BALTIMORE, MD.

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One of the basic castings under construction

OLOFSSON

Designers and Builders of Tools, Dies, Jigs, Fixtures and Special Machines.

This giant automatic grinder, weighing 40 tons and capable of top and bottom snag grinding a motor block every 21 seconds, has just been built by us for one of the large motor manufacturers of the country. The Olofsson organization may be able to build for you some machine requiring similar craftsmanship.

OLOFSSON TOOL AND DIE COMPANY

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For the "DRIVE" that Must NOT Fail in War or in Peace

For THAT VITAL SPOT where POWER TAKES HOLD OF THE LOAD!

You Can Depend on—

BORG & BECK

The Standard Clutch in Peace or War!

ENGINEERING B-W PRODUCTION

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CHICAGO, ILLINOIS

Here's a Tip on PLASTICS...

from Your Wife!

IMAGINE YOUR WIFE baking a new kind of cake without a recipe! Or without the exact ingredients the recipe calls for!

Now transpose the situation to plastics—where precision is everything. Here again there's no substitute for the right "recipe" to meet the needs of each plastics application, each group of specific requirements.

Today the mere specification "plastics" is meaningless. Plastics exist in endless variety. Types within types. Each classification joins many desirable qualities. And limitations too. There just isn't any one plastic to meet every need.

We specialize in *thermoplastics*—the cellulosic group—a distinct and versatile class of synthetics covering a wide segment—but a segment, mind you—of the plastics field. This is the group which is the most widely applied to civilian living.

The family name for one group of Celanese plastics is Lumarith, widely known for durability and limitless color range. Included are types of plastics—Lumarith C.A., Lumarith X and Lumarith E.C.—the initials signifying the plastic base. For instance, in these three cases, cellulose acetate, high acetyl cellulose acetate and ethyl cellulose, respectively.

Yet that's only the beginning of precision thermoplastics. The Lumarith C.A. group alone includes hundreds of formulations. Each emphasizes a class of properties in the finished product. Perhaps impact, tensile or structural strength, toughness, heat resistance, moisture resistance, dimensional stability, transparency, color, economical production. All these, and many more, can be had with varying emphasis upon one or more qualities.

Pioneering plastics 75 years ago, the Celanese plastics division has consistently stressed technical service, the key to outstanding results in plastics applications. Painstaking technical service assures precision selection of the right formulations. Architecturally speaking this is fully as important as care in planning the foundation of a building.

The essence of the Celanese technical service is a sense of responsibility for *all* plastics no matter whose. Here, a misapplication of any plastic is considered a "black eye" for the entire industry. We unfailingly commend the best material for the job, and we don't hesitate to rule out Lumarith when another material is indicated. In the interests of better products we suggest you urge your suppliers to talk to our Technical Service Department early in their plans. Celanese Celluloid Corporation, The First Name in Plastics, a division of the Celanese Corporation of America, 180 Madison Avenue, New York 16, N. Y.

LUMARITH* *A Celanese* Plastic*

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CONSTANT VELOCITY—no periodic acceleration and deceleration
Improves traction
Reduces tire scuffing
Shortens turning radius
Eliminates noise and vibration
Lengthens life of drive line

New Process TRACTA JOINT

ONLY 4 SIMPLE PARTS

No Tools Required for Assembly or Disassembly

Fifteen years of American and European development and refinement—plus outstanding performance on the battlefields of Alaska, Africa, Europe, Asia and the South Pacific—make the New Process TRACTA JOINT the ideal universal for postwar applications. Especially in—

1. Multiple-drive vehicles such as the T22 combat wagon illustrated, which is fully equipped with Tracta Joints.
2. Four-wheel-drive and/or independently-sprung-wheel-trucks and cars.
3. Earth-movers and other off-the-road vehicles where the angularity of the power drive covers a wide range.
4. Motor boats, machine tools and those applications where precision alignment of the drive is rarely secured, or is subject to deflection.

Tracta Joints provide the large torque capacity required by increasingly more powerful engines and increasingly heavier loads. Write for sizes, torque capacities, operating and test data.

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. . . FOR ANY KIND OF WELDING

for welding Stainless • **PAGE** offers a complete line of electrodes, developed in cooperation with the world's largest producer of Stainless Steel. Coatings on **PAGE** *Allegheny* Stainless Steel Electrodes are constantly checked for uniformity, so that your good welders can depend upon uniform welds.

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ESSENTIAL PRODUCTS • TRU-LAY Aircraft, Automotive, and Industrial Controls • TRU-LOC Aircraft Terminals • AMERICAN CABLE Wire Rope • TRU-STOP Brakes • AMERICAN Chain • WEED Tire Chains • ACCO Malleable Castings • CAMPBELL Cutting Machines • FORD Hoists, Trolleys • HAZARD Wire Rope • MANLEY Auto Service Equipment • MARYLAND Bolts and Nuts • OWEN Springs • PAGE Fence, Shaped Wire, Welding Wire • READING-PRATT & CADY Valves • READING Steel Castings • WRIGHT Hoists, Cranes • WILSON "Rockwell" Hardness Testers

In Business for Your Safety

"HERE, ROSIE, THE RIVETER
is one of the reasons
you can do your job so well"

Scotch tape holds a row of rivets in place for you, doesn't it, Rosie . . . multiplies your production on your vital job? Well, yours is just one of the thousands of important war or civilian uses for such tape.

Obviously, tape production mustn't be interrupted. Moreover, quality must remain uniform.

And that's where Bowser Exact Liquid Control comes in. Years ago, one of America's largest producers of industrial tape installed Bowser Meters to measure precisely the various ingredients that give tape adhesive the proper consistency. Then other Bowser Meters measure the flow of adhesive on the backings of cellophane, paper or other materials.

But there was another tough problem—rust and dust in the adhesive solvent caused the backing sheets to tear as they passed through the applicator machine. There were frequent costly shutdowns. How were they licked? By a Bowser Filter, which clears the solvent.

Visit other departments of this company and you'll find still other Bowser equipment doing work that couldn't be done as well, if at all, by any other method. For instance, at the quartz mines Bowser Lubrication and Filtration units keep the crushers running smoothly. And at the furnaces where ground quartz is prepared for use in roofing material, Bowser Meters control the flow of fuel oil.

Possibly your plant doesn't need this many different phases of liquid control, but somewhere in your plant there is a job that can be done better by a Bowser Meter, Filter, Proportioner, Lubrication System, Oil Conditioner, Pump or one of the many other Bowser products. A Bowser engineer will gladly consult with you. Write to us today. BOWSER, INC., Fort Wayne 2, Indiana.

BOWSER

THE NAME THAT MEANS EXACT CONTROL OF LIQUIDS

Not only has Bowser's war production earned the Army-Navy E...Bowser equipment has helped earn it for scores of other companies.

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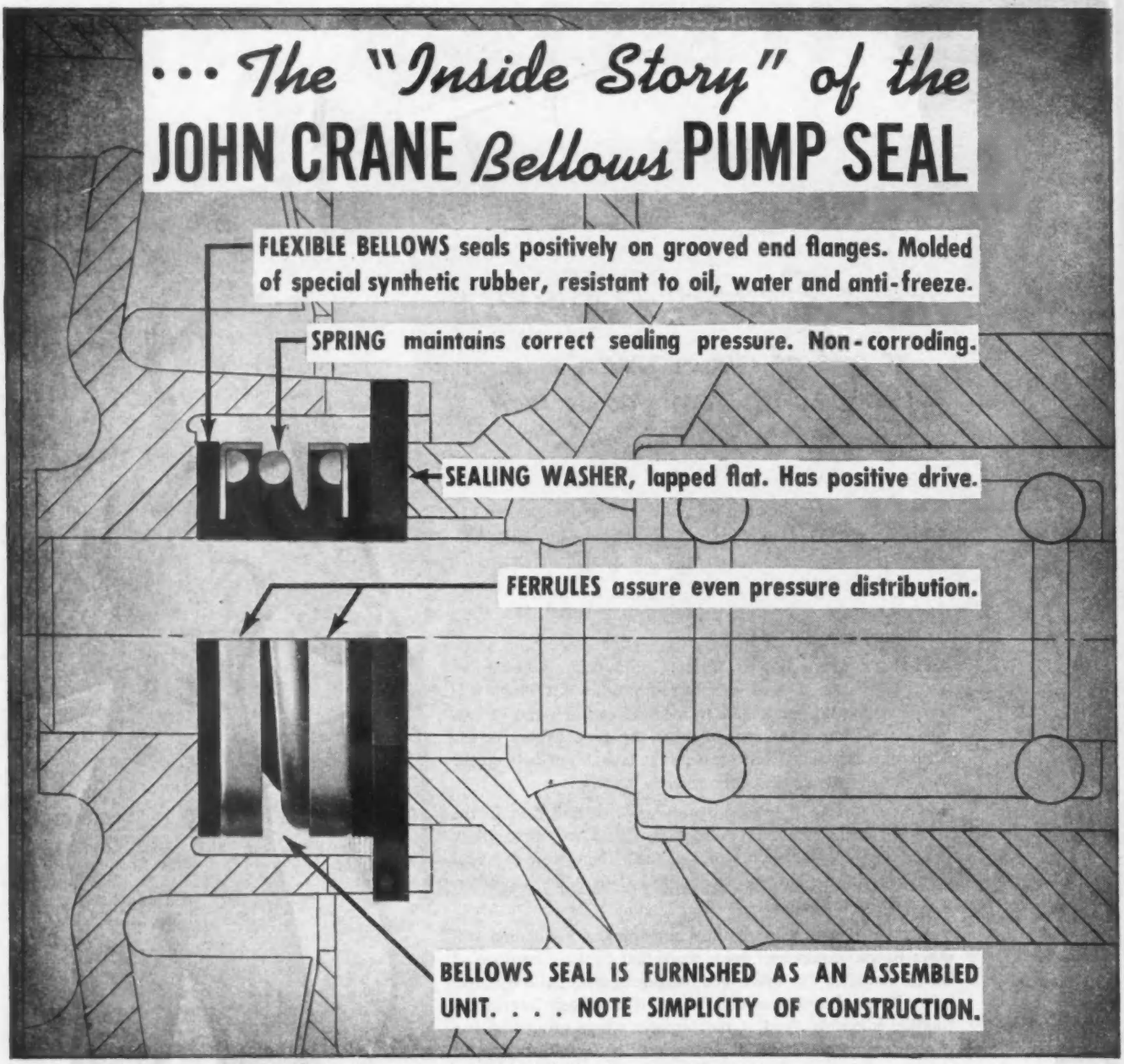
... The "Inside Story" of the
JOHN CRANE Bellows PUMP SEAL
FLEXIBLE BELLOWS seals positively on grooved end flanges. Molded of special synthetic rubber, resistant to oil, water and anti-freeze.
SPRING maintains correct sealing pressure. Non-corroding.
SEALING WASHER, lapped flat. Has positive drive.
FERRULES assure even pressure distribution.
BELLOWS SEAL IS FURNISHED AS AN ASSEMBLED UNIT. . . . NOTE SIMPLICITY OF CONSTRUCTION.

Illustration shows typical installation in automotive water pump.

Note These Advantages:

- **Spring and bellows are flexible—self-adjusting.**
- **Bellows and washer turn with the shaft; there is no wear on the bellows.**
- **Quick, correct installation is assured. Bellows assembly fits shaft loosely; slides freely into place, either end first (the two ends are identical).**
- **Service tests show the John Crane Bellows Seal operating perfectly after 100,000 miles and more.**

Ask for Illustrated Bellows Pump Seal Bulletin.

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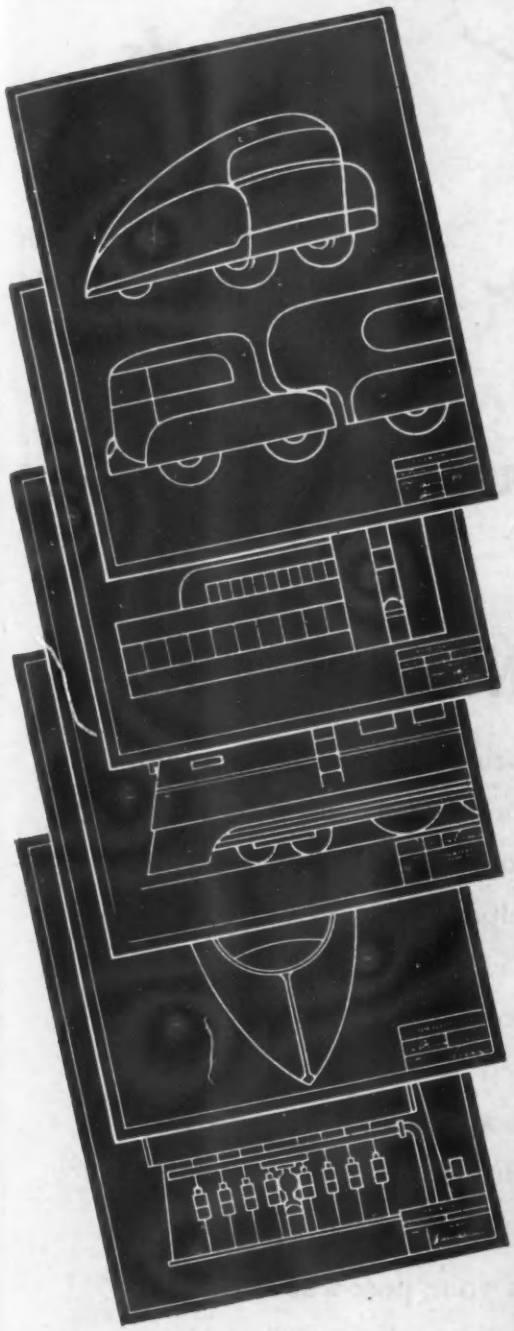
WITH LOW COST, QUALITY BLUEPRINTS AT HIGH SPEED...30 FEET PER MINUTE



Whether you use the services of commercial blueprinters, operate your own reproduction department, or are planning to install one, you will find Blueprints are the best, the fastest, and the cheapest per square foot of all tracing reproductions (as low as a cent and even less).

PEASE "22-16", illustrated, using good tracings and fast paper produces easy to read, permanent Blueprints with sharp lines, at 20 feet per minute. Pease "22", not illustrated has a production speed of 30 feet per minute.

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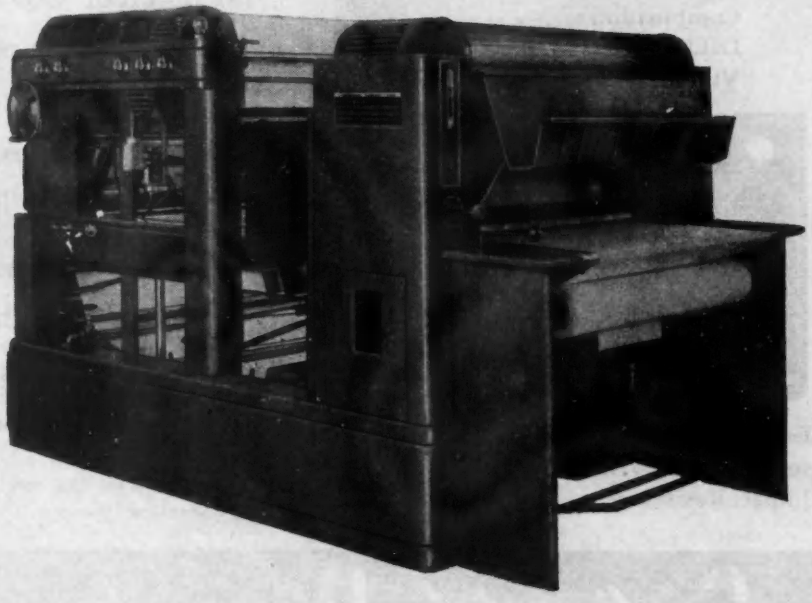

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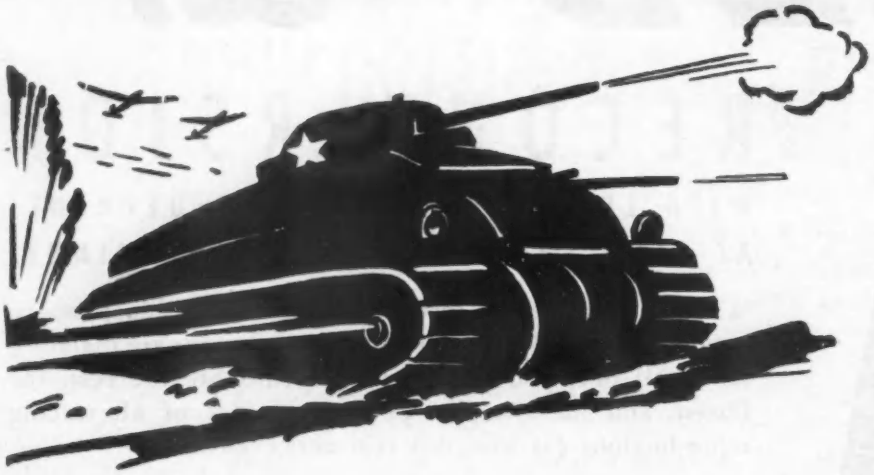


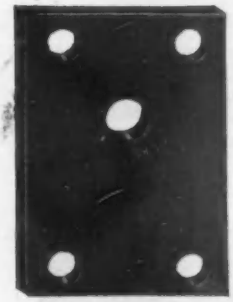
depends on accurate controls

which must function in spite of heat . . . cold . . . humidity . . . dryness

The ELECTRICAL INSULATING PARTS must be rugged

Paper Base DILECTO radio insulator...Strong, High Dielectric part.

Combination DILECTO-Neoprene Vibrator Plug.



Fabric Base DILECTO Insulating Base...for High Impact Resistance.

CL-44

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Electrical Insulating Materials are engineered to meet specific mechanical, electrical and thermal problems. With many years of experience helping customers apply the 6 different C-D electrical insulating materials to specific problems... C-D technicians have accumulated a wealth of "Know How," which is at your disposal to help you solve your insulating problem.

C-D technicians welcome an opportunity to help you with your post-war designs as well as with your immediate "What Material?" problem. Send for Bulletin GF today.

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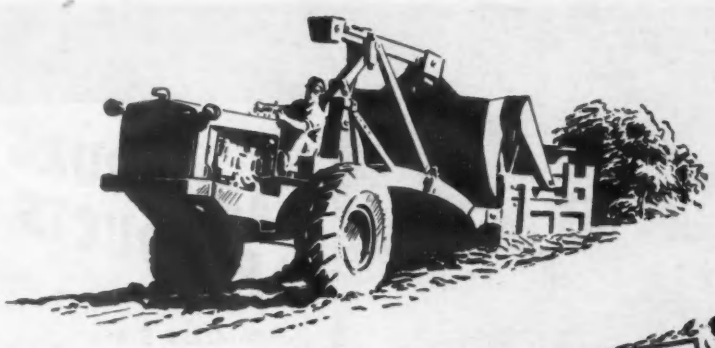
Established 1895.. Manufacturers of Laminated Plastics since 1911—NEWARK 2 • DELAWARE



Exides have the power and stamina needed for the heavy tasks of today

Power, and more power! Sturdiness, too! These are among the engineering "musts" of today—especially for automotive vehicles designed for heavy-duty service. Power and sturdiness are also Exide "musts." And you'll find ample reserves of each in Exide Heavy-Duty Batteries.

These vigorous, dependable Exides are supplying electrical power for "on" and "off" the highway equipment in some of the toughest spots on the globe. And they are doing an excellent job—even where climates are extremely severe, and where working conditions call for all that man and machines can give.

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Write today for a FREE copy of the Exide Catalog on Heavy-Duty Batteries. It contains accurate, clear, concise information on Exide Batteries for cranking Diesel Engines.

ARMY E NAVY

Exide
HEAVY DUTY BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

DON'T WAIT UNTIL PEACE COMES

WHILE we prepared for this war virtually "over night", transition to peacetime pursuits is not going to be so rapid. It is one thing for all of us, individuals and industrialists, to rush to the rescue of our common cause, under the rules and regulations which have been designed and perfected by experts in national defense. It is going to be quite another, *slower,* undertaking for each of us to find his way back to the endeavors of his own preference and of his own natural bent.

For months Harrisburg Steel Corporation has been planning for peace without interrupting its important part in the progress of this war. Those peacetime plans include the advantages and advancements accelerated by war time production which insures improved production and service of the seamless and drop-forged equipment for which we are famous.

HARRISBURG
STEEL CORPORATION
HARRISBURG • PENNSYLVANIA

HARRISBURG PRODUCTS

SEAMLESS STEEL CYLINDERS
Plate-made of maximum uniformity, conforming to highest standards in use, insurance and safety laws.

CO_2 LIQUEFIERS
with the famous Harrisburg closure. No moving parts, trouble proof. Will not leak at *any* pressure.

SEAMLESS STEEL PIPE COUPLINGS
Forged from solid billets of steel made in our own Open Hearth. Threaded by a special process developed by Harrisburg.

SEAMLESS STEEL SLUSH PUMP LINERS
are noted for perfection as to diameters and threading as well as their high resistance to abrasive action. Made of our own steel.

DROP-FORGED PIPE FLANGES
Famous for their strength and endurance, accurately machined. Available in all sizes and types.

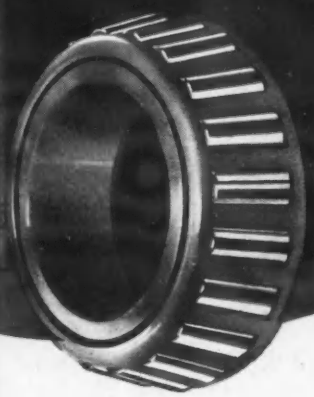
ALLOY AND CARBON STEELS
Approximately 50% of all Harrisburg steel is alloy steel, necessitating first class quality in pig iron, scrap and new alloy. Harrisburg high carbon steel is noted for its hard wear, resisting surface and tough shock resisting core.

RESEARCH AND DEVELOPMENT
Harrisburg equipment for making fine steel embraces everything from recognized authorities in engineering metallurgy, chemistry and design to the smallest auxiliary equipment in any way essential to the expert production of fine products.

Smoothness IS THE THING

Bower Roller Bearings in tractors defeat friction through surface smoothness refined to millionths of an inch—the highest degree of precision known to the bearing industry.

BOWER ROLLER BEARINGS



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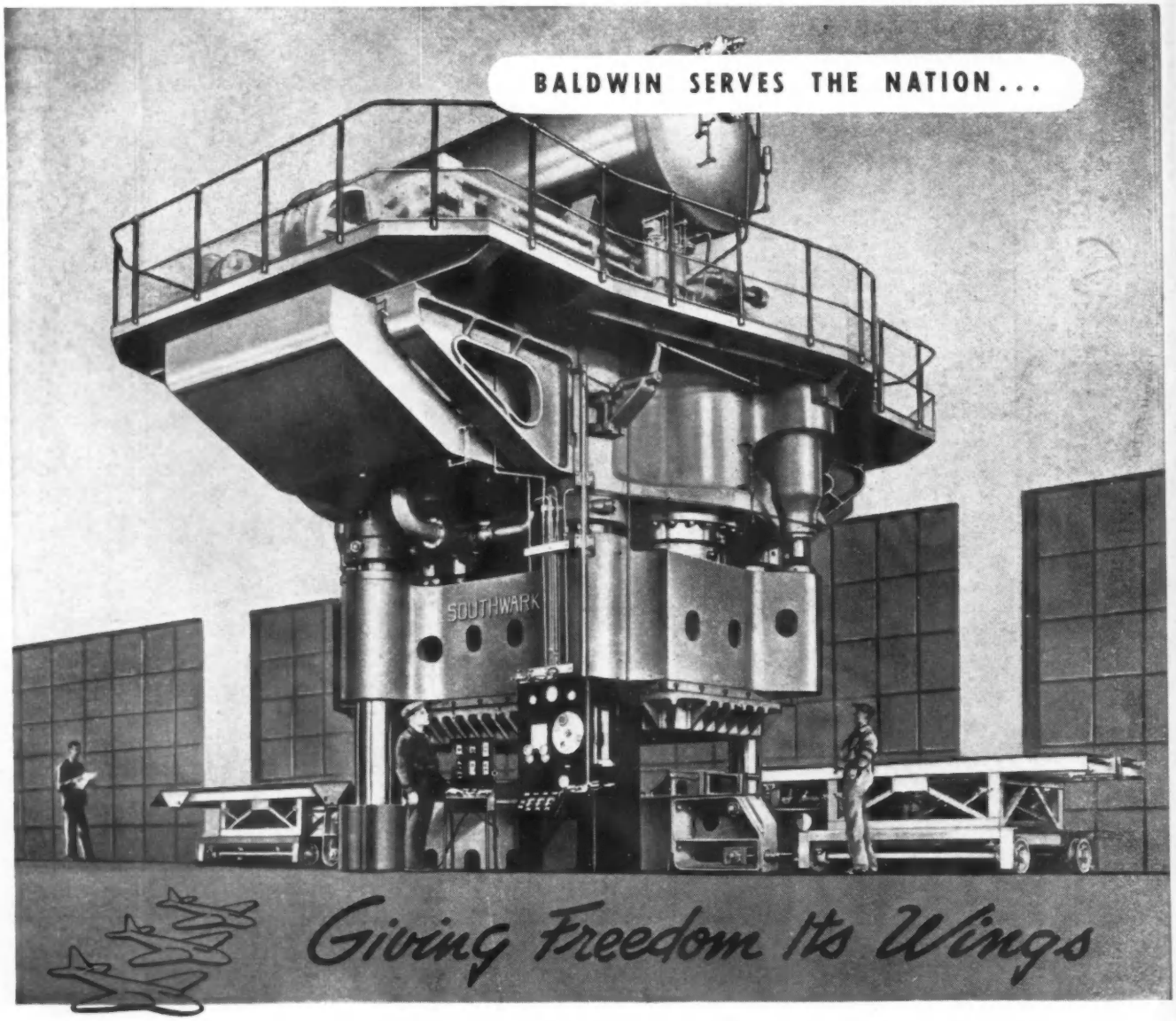

When the astronomical quota on U. S. plane production was set, aircraft manufacturers needed special presses, as quick as *yesterday*.

Fortunately, Baldwin didn't have to stop and learn *how* to build such equipment; 30 years of experience in building thousands upon thousands of presses took care of that. Manufacturers told what they wanted the presses to do . . . and Baldwin built them to do it.

You may have some production problems . . . current or post-war . . . that the right press could solve better than anything else. If so, the same Baldwin brains that served the aircraft industry are ready to serve you. Baldwin Southwark Division, The Baldwin Locomotive Works, Philadelphia, Pennsylvania, U. S. A. Pacific Coast Representative: The Pelton Water Wheel Co., San Francisco, California. In Canada: United Steel Corp., Toronto.

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PRODUCTS

Hydraulic presses
Testing equipment
Steel forgings and castings
Diesel-electric locomotives
Diesel engines
Metal plate fabrication
Rolled steel rings
Bronze castings
Heavy machine work
Crane wheels
Bending rolls
Plate planers
Babbitt metal
Alloy iron castings
Briquetting presses

BLW THE BALDWIN GROUP

BALDWIN
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LOOK TO FENN FOR YOUR SPECIAL MACHINERY NEEDS

3 Generations of Fenns have specialized in building machinery. They have the designing and engineering skill backed by years of craftsmanship and experience.

REDESIGNING MACHINERY for Profitable Post War Production

If you are thinking of redesigning old machines or building new ones, it is time to plan NOW.

Fenn Aircraft BUILT PARTS FOR FAMOUS PLANES

Today Fenn is wholly engaged in war production. Thousands of precision parts and subassemblies flow from Fenn Plants into the construction of such famous planes as the Navy Corsair. Other Fenn parts and assemblies are made for ships, tanks, guns and vital war equipment.

FENN Plants - Strategically located for Efficient Service

Fenn plants, located at Hartford and New Britain, will once again build special machinery at the close of the war. The men with the skill and experience to solve machine design and development problems, will be ready to work with you. Planning, blueprinting and engineering can be done now. Your inquiries involve no obligation.

Experienced Designers and Machine Builders With A Long-Time Reputation for Precision Workmanship. We invite your inquiries.

THE FENN MANUFACTURING COMPANY

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QUALITY FORGINGS

THERE IS NO SUBSTITUTE FOR *Quality Control*

New forging techniques—especially in the field of heavy drop forgings—afford greater latitude in design.

Our engineers are available now for consultation on your postwar products.

DROP FORGINGS UP TO 1,800 lbs.

HAMMERED FORGINGS UP TO 10,000 lbs.

TO MARK PROGRESS

ARMY-NAVY

LADISH DROP FORGE CO.

CUDAHY • WISCONSIN

MILWAUKEE SUBURB

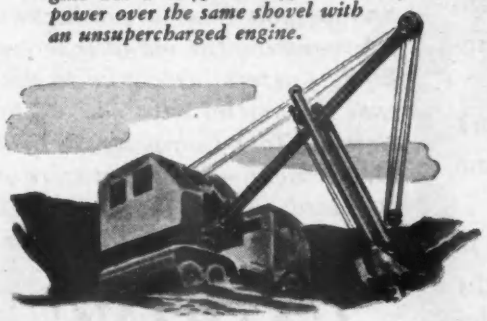
The Riveter's Helper Runs a *Supercharger*

The principle of supercharging has been indispensable to the progress of mankind from the earliest times. The working of metals into useful articles began when means were found to produce high temperatures in a charcoal fire by increasing the rate of delivery of air. The ancients accomplished this by having two or more helpers teeter back and forth on bag blowers. Today, the riveter's helper gets his rivets red hot by turning a centrifugal blower geared to produce a strong blast.

Blowing air under pressure into the cylinders of a diesel, gas, or gasoline engine is another and more advanced application of the basic principle of supercharging. In one case the resulting higher rate of combustion of the fuel produces a hotter fire — in the other it develops more power per piston stroke.

B-W has pioneered in the application of supercharging to internal combustion engines. Our engineers are at your service in designing engines for supercharging as original equipment or for later application.

The power shovel with a supercharged engine has a 25% to 40% reserve of extra power over the same shovel with an unsupercharged engine.



ENGINEERING B-W PRODUCTION

SUPERCHARGERS, INC.

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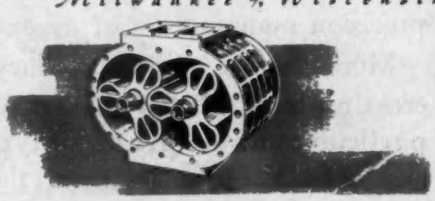
A DIVISION OF BORG-WARNER

Milwaukee 9, Wisconsin

The B-W Positive Displacement Supercharger is closely sealed and precision-built for efficient and reliable operation.



A Tool that tells a story

This heavy duty *inserted blade* boring, chamfering and facing tool was designed and custom built to solve a specific, high production metal cutting problem. Rugged simplicity and interchangeable cutter heads and blades are combined.

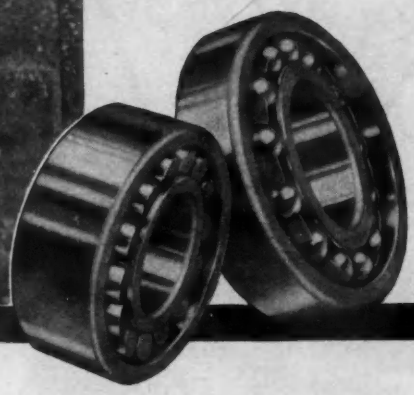
It is used here as a symbol because it is typical of the work Gairing engineers and craftsmen are doing in the design and precision manufacture of inserted blade cutters.

More than a quarter century of specialized experience in creating tools of this character has naturally taught us the particular advantages of all types of Gairing inserted blades and locks. We use all of them: the type best suited for the need.

Should you have a production job requiring the use of Inserted Blade Cutters, we'd like to discuss the matter with you • The Gairing Tool Company, Detroit 32, Michigan—Manufacturers of standard, special and Gair-Lock inserted blade cutting tools.

GAIRING

Photo courtesy
HIGHWAY EXPRESS
LINES, INC.



Start 'em right

and they'll end right

Every time the item, "bearing replacements", pops up on the maintenance sheet it's bad news for fleet superintendents. Bearings are hard to get because the armed services are hungry for them. So it behooves the super to have his crew handle bearings with kid gloves. If they mount bearings correctly, the bearings will get off to a good start. An arbor press fit, for instance, assures proper alignment and shaft seating because force is applied directly against the inner race. Tapping a plate against the end of a pipe is a similar method. The more care given to proper installation, the fewer times the item, "bearing replacements", will appear. 5549

SKF INDUSTRIES, INC., PHILA. 34, PA.

SKF

ball and roller bearings

ENGINEERING *the* ARROW

THE CLUB
THE AXE
THE ARROW

... each was an important step upward on the ladder of the ages. Each embodied the elimination of weight and gave more power and greater range to the hand of man. Each required the highest engineering and production skill of its day. Today the Guiberson Diesel, backed by more than 25 years of precision production of oil tools and more than 15 years of engineering and production of diesel engines, is the fleet arrow of tomorrow's transportation on sea, on land and in the air. It is the light weight power plant that is safer, more economical and more efficient.

PRODUCERS OF OIL TOOLS, OIL HEATING UNITS, AIRCRAFT PARTS AND D I E S E L S

25 BETTER BE SAFE THAN SORRY GUIBERSON

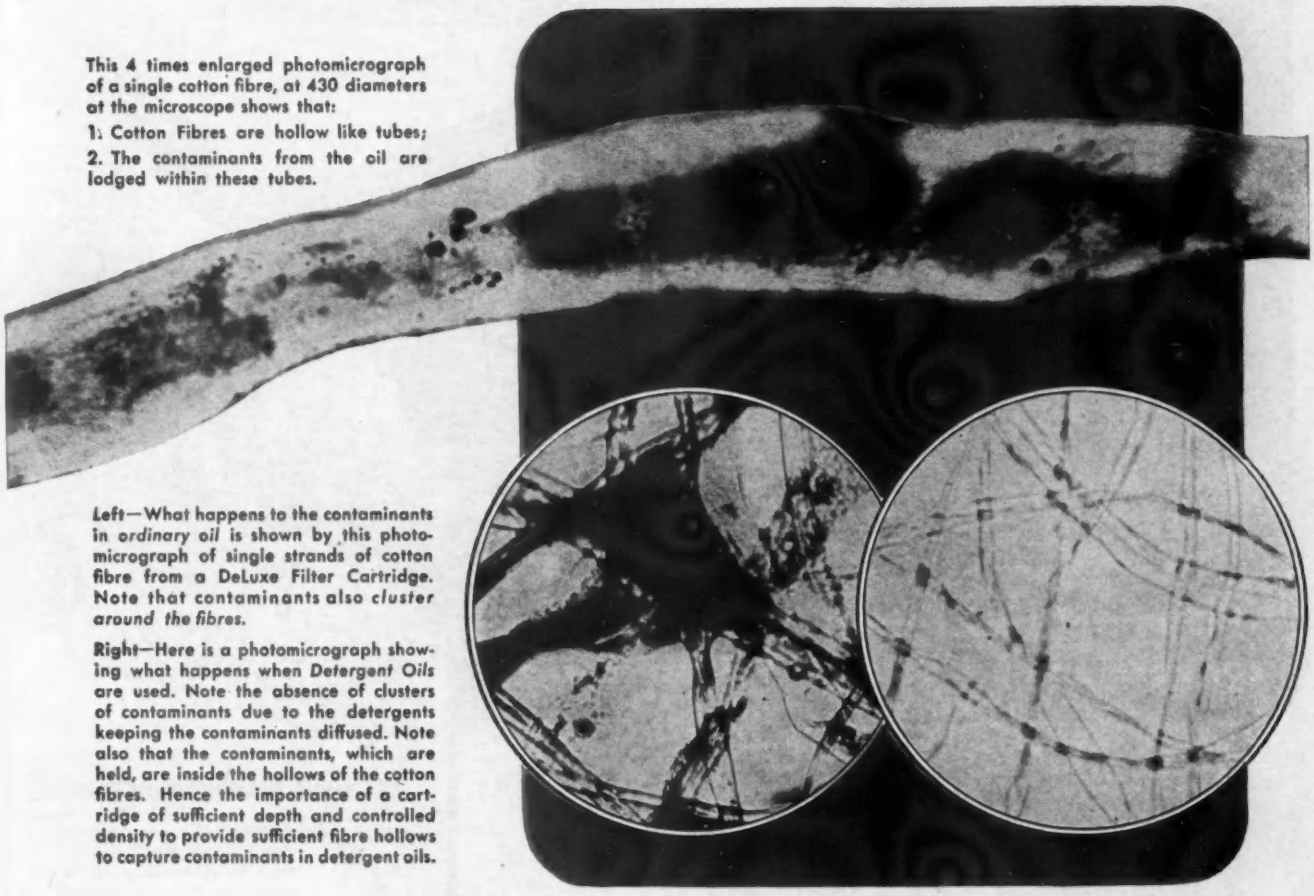
ESTABLISHED 1919

U. S. A.

Guiberson

THE GUIBERSON CORPORATION
GUIBERSON DIESEL ENGINE COMPANY
DALLAS, TEXAS

PhotoMicrographs reveal importance of DeLuxe controlled depth cleansing



This 4 times enlarged photomicrograph of a single cotton fibre, at 430 diameters at the microscope shows that:

1. Cotton Fibres are hollow like tubes;
2. The contaminants from the oil are lodged within these tubes.

Left—What happens to the contaminants in *ordinary oil* is shown by this photomicrograph of single strands of cotton fibre from a DeLuxe Filter Cartridge. Note that contaminants also *cluster around the fibres.*

Right—Here is a photomicrograph showing what happens when *Detergent Oils* are used. Note the absence of clusters of contaminants due to the detergents keeping the contaminants diffused. Note also that the contaminants, which are held, are inside the hollows of the cotton fibres. Hence the importance of a cartridge of sufficient depth and controlled density to provide sufficient fibre hollows to capture contaminants in detergent oils.

for Detergent oils and All oils!

Controlled Depth Filtration made possible in the DeLuxe Filter by the Cartridge with the Spring and Cone is important in the actual cleansing of regular oil. Its importance is greatly increased, as shown by the photomicrographs above, in cleansing detergent oils. For further data on the DeLuxe principles of Oil Cleansing, write for free booklet. There is no cost or obligation. We will be happy to have your inquiry. DeLuxe Products Corporation, 1414 Lake Street, LaPorte, Indiana.

DELUXE *Oil Filter*

DOES MORE THAN STRAIN OIL...MORE THAN FILTER OIL
ACTUALLY CLEANSES OIL

Design that part in ArmaSteel*

This metal has what it takes to speed conversion . . . cut costs . . . save time

That's a big claim to make, but it's backed up by past and present performance records of ArmaSteel in scores of varied applications—in automotive parts, Diesel parts, appliance parts and armament parts.

The important facts are these: ArmaSteel is a versatile metal with a wide range of physical characteristics, available in any yield strength up to 90,000 pounds per square inch. ArmaSteel provides 10% to 30% better machinability than steels of comparable hardness. Arma-Steel, cast close to the finished shape of the part, reduces the amount of metal to be removed to a fraction of former requirements. ArmaSteel increases the number of parts finished per tool grind as much as 100%.

To quote one case history as an example of what Arma-Steel can do, a certain part weighing 3 pounds required the removal of nearly 22 pounds of metal when machined from bar stock. Machining time was 16 to 18 hours. When ArmaSteel took over, the amount of metal to be removed was reduced to less than 6 pounds—machining time cut to 2 hours.

These *plus* ADVANTAGES are ready to work for you

EXCELLENT BEARING PROPERTIES

ArmaSteel's non-seizing characteristic eliminates the need for bronze bushings in valve rocker arms. Adaptability to selective hardening permits tip of arm to be hardened to specifications in lead bath.

GOOD FATIGUE LIFE

The record of Arma-Steel's performance in Hydra-Matic transmission gear illustrates the long life of ArmaSteel parts in many applications.

POLISHES TO MIRROR FINISH

ArmaSteel pistons illustrate the mirror finish obtainable with this unique metal. In heavy-duty service in Diesel engines ArmaSteel pistons have established exceptional performance records.

CAST FOR A LEADING ***ROLE IN INDUSTRY***

WAR BONDS ARE SAVING AMERICAN LIVES

SAGINAW MALLEABLE IRON DIVISION OF GENERAL MOTORS

SAGINAW, MICHIGAN

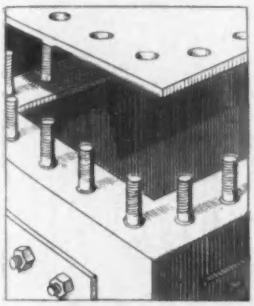
*Reg. U. S. Pat. Off.

SEE THIS "GUN" AT THE NATIONAL METAL CONGRESS CLEVELAND, OHIO OCTOBER 16-20

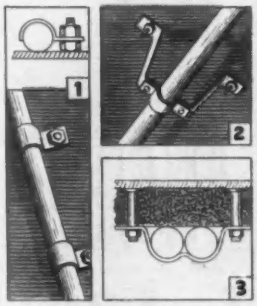
NELSON *Electric Arc* STUD WELDERS

—end-weld studs in less than one-half second!

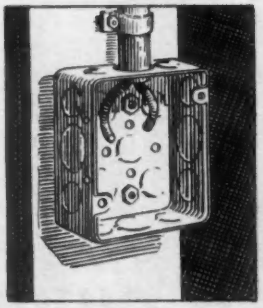
SOME WAYS 460 INDUSTRIAL PLANTS AND SHIPYARDS ARE USING IT!



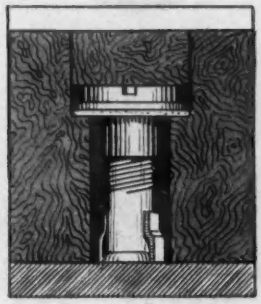
Inspection covers of all types can be secured with Nelson Studs. No drilling holes through casings, or hand welding studs. Studs are automatically welded in less than ½ second. No leaking, no loosening! The weld is stronger than the stud.



Wiring, conduit, and pipe are quickly secured. Here illustrated are a few of many methods: 1. Securing conduit. 2. Securing pipe (single or multiple runs). 3. Securing wiring of all kinds over soft insulation materials.



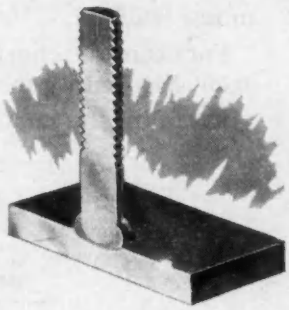
Electrical equipment of all kinds, outlet boxes, circuit breakers, etc., can be secured without drilling metal beams or welding small pads. Accurate locating is easy because all Nelson Studs are pointed. The economical way to secure small parts.



Wood flooring is secured over metal beams with studs. The flooring is laid, and holes drilled where desired. Studs are welded through the holes and nuts and washers tightened down. A wooden plug is then tapped in to complete the job.

For general maintenance of all kinds the Nelson welder is excellent. It will end-weld studs to metal for any kind of repairs. For securing oil lines with straps; for inspection and ventilator covers; air lines; car repair; and for general work of all kinds around the shop.

The Nelson Stud Welder is completely portable and light in weight. Proven by five years of actual use and used by more than 460 industrial plants it can be employed wherever there is need to end-weld studs to metal. Excellent for repair and maintenance work of all kinds. ***Write to the address below for complete details and catalog.***



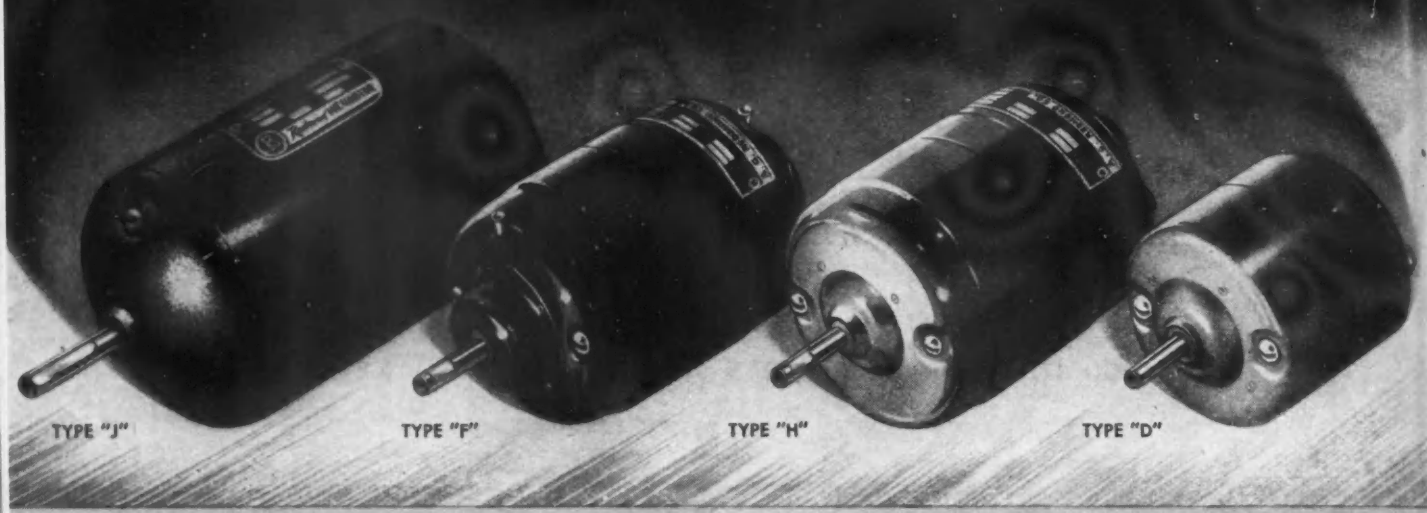
Cutaway view shows complete fusion of weld between stud and plate. ***The weld is stronger than the strength of the stud.***

NELSON SPECIALTY
WELDING EQUIPMENT CORPORATION

Dept. AV, 440 Peralta Avenue, San Leandro, Calif.

Eastern Representative: Camden Stud Welding Corp. Dept. 122, 1416 So. Sixth St., Camden N. J.

DEPENDABLE



Redmond MICROMOTORS
FOR DIRECT CURRENT APPLICATIONS

THEY'RE ready right *now* for your post-war planning. These fine Micromotors for a tenth horsepower and less have been thoroughly thought out and tested for performance, long life, and above all, dependability.

You should get all the details on the array of important features available in the Redmond DC line.

For example, check the quiet, smooth operation assured by modulated magnetic fields.

Examine the cushion mounted armatures that absorb shocks from uneven loads.

Inspect the fine construction evidenced in micro-tolerances, impregnated windings, quiet commutation and power saving laminations.

Consider carefully the extra span of life provided by large oil reservoirs and direct feed lubrication.

Write us today for complete information on Redmond DC Micromotors. Let our engineers assist you in selecting the correct power unit for your product.

DC MICROMOTORS ILLUSTRATED ABOVE

TYPE "J" for 1/20th to 1/10th hp., at 6 to 115 volts. Heavy duty construction with cast end caps, tubular steel housing and super capacity oil reservoirs. **TYPE "F"** for 1/20th hp. and less, at 6 to 115 volts. Heavy duty light weight design with extra capacity external oil reservoirs. **TYPE "H"** for 1/20th hp. and less, at 6 to 115 volts. Highly efficient light weight design. **TYPE "D"** for 1/75th hp. and less, at 6 to 32 volts. Small size light weight construction.

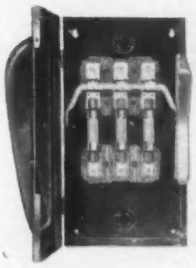
A. G. Redmond Company

REDMOND

Composite sketch of Redmond facilities with over 5 acres of floor area.

OWOSSO, MICHIGAN, U. S. A.

Pre-eminent!



Vacu-Break SAFETY SWITCHES WITH "CLAMPMATIC" CONTACTS

Even if we wished, we could not meet the nation's total demand for Safety Switches . . . But it is gratifying to realize that we are attracting the greater part of the business placed by users who insist on highest quality.

This they get in BullDog with its exclusive Vacu-Break principle of arc suffocation . . . *plus* the Clampmatic feature which assures contacts tight as a bolted connection . . . *plus* stylined cabinets of modern design . . . all at no price penalty! They pay no more but get a lot more!

Capacities from 30 Amp. to 1200 Amp.

BULLDOG

ELECTRIC PRODUCTS COMPANY

BOX 177, R. PK. ANNEX, DETROIT 32, MICHIGAN
In Canada: BullDog Electric Products, Ltd., Toronto
Field Engineering Offices in All Principal Cities

Buy More War Bonds

Also Manufacturers of
SafetoFuse Panelboards—Switchboards—Circuit Master Breakers—BUStribution Duct, for "plug-in" power—Universal Trol-E-Duct, for flexible lighting—Industrial Trol-E-Duct, for movable "loads."

We have outgrown our name . . . . . .

ACME
Aluminum Alloys
INC.

BECAUSE the name Acme Pattern & Tool Company, Inc. no longer adequately describes the scope of our operations, we are changing our corporate name to Acme Aluminum Alloys, Inc.

This marks the second time we have changed our name to keep pace with the remarkable growth which this company has made since its beginning less than 25 years ago.

Our production of aluminum alloy castings . . . permanent mold and sand . . . has grown to such volume, that in floor space, equipment and output the Acme foundry today ranks among the first four or five aluminum foundries in the United States.

Our pattern, tool and die departments, and our design and engineering service, continue unchanged, but will operate as the Acme Pattern & Tool Division of Acme Aluminum Alloys, Inc.

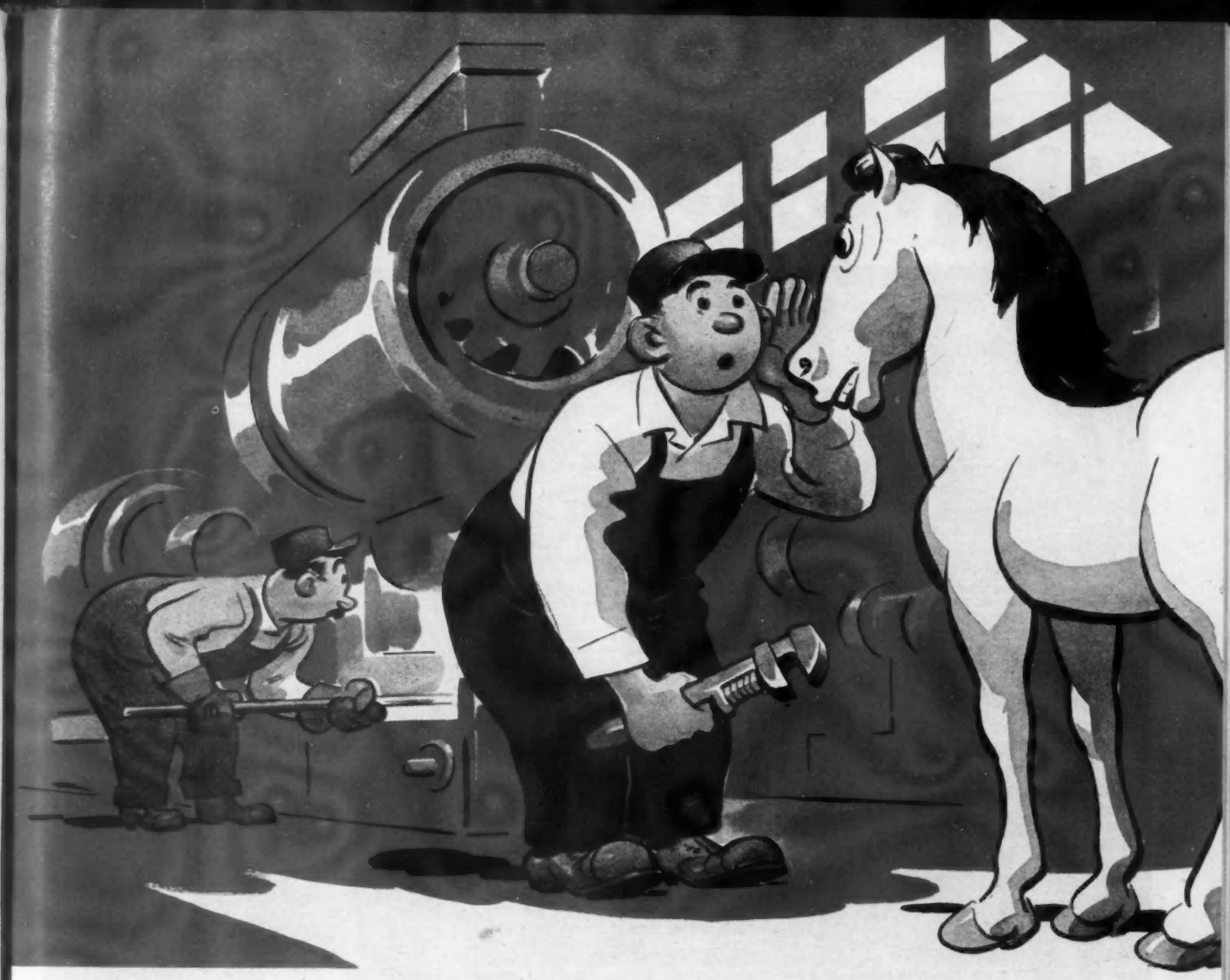
We shall be glad to submit recommendations and estimates on your current or future aluminum castings requirements.

FOR VICTORY
BUY
WAR BONDS
AND STAMPS

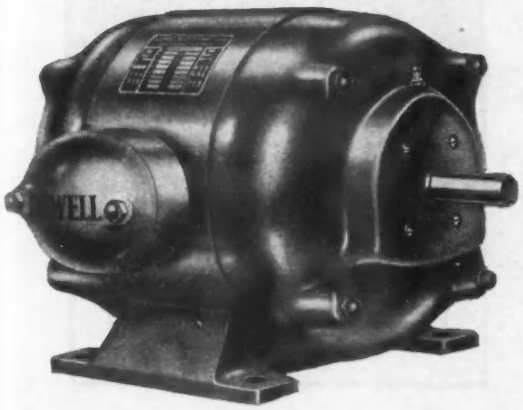
ARMY E NAVY

ACME *Aluminum Alloys, Inc.*
DAYTON 3, OHIO
HEAT-TREATED ALUMINUM ALLOY CASTINGS

ACME PATTERN & TOOL DIVISION
PATTERNS · TOOLS · TOOL DESIGNING · PRODUCTION PROCESSING



Don't Be Fussin' and Fixin'— Get Horsepower by Howell



The Howell Protected Type Motor, shown, gives complete protection against dripping liquids, metal chips and other falling particles. Completely streamlined — utilizing non-breakable steel frame — malleable or steel base — cast iron end plates and cast iron, weatherproof terminal box are standard construction features. Special horizontal and vertical mountings are available.

Available in sizes 5 H.P. and smaller.

REPAIR MAN: I'd like to wrap this wrench around the guy's neck who insulated this motor.

HORSE: I know how you feel about sloppy work.

REPAIR MAN: Here we are at the peak of production, and what happens? Motor failure . . . tear down the machine . . . lose time . . . get behind — all because the motor wasn't built right in the first place.

HORSE: My good man, stop worrying! Use Howell Motors. The entire stator of every Howell Motor is triple-treated with Howell Bond varnish. It is made to withstand temperatures up to 350° F.— is water and oil proof and grease resisting, and it will not break or crack. The rotors are copper, too, and the best grade bronze or ball bearings are used. You just can't buy better motors.

REPAIR MAN: That's right! I know it! I'm specifyin' HOWELL for all my new jobs.

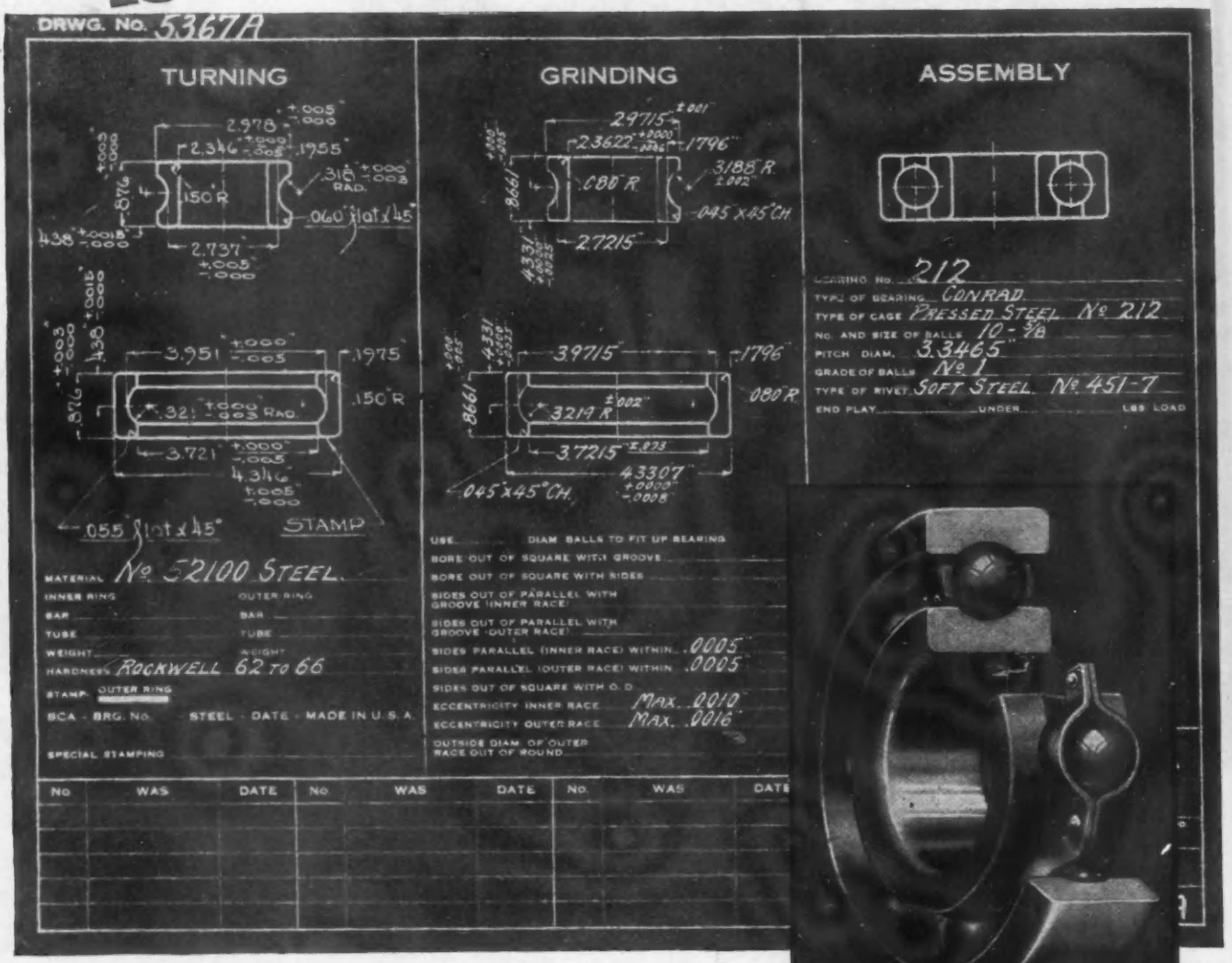
Phone the nearest Howell representative today, or write direct to the factory for prices, data and delivery dates on Howell standard or specialized motors for every industry, up to 150 Hp.

HOWELL ELECTRIC MOTORS COMPANY

HOWELL, MICHIGAN

Manufacturers of Quality Motors Since 1915

A blueprint FOR NEW EQUIPMENT DESIGNERS



ON drafting boards all over the country, designs for new equipment are being whipped into shape. This blueprint of a BCA Radial Bearing will fit smoothly into many a new design picture.

For no matter how much design may alter machine structure, it cannot alter the fact that motion creates friction. Turning shafts and moving parts will still call for ball bearings.

BCA Ball Bearings are designed and constructed to meet varying conditions of friction, wear and load. They deserve thorough consideration in relation to *your* new equipment blueprints.

BEARINGS COMPANY OF AMERICA, LANCASTER, PENNSYLVANIA

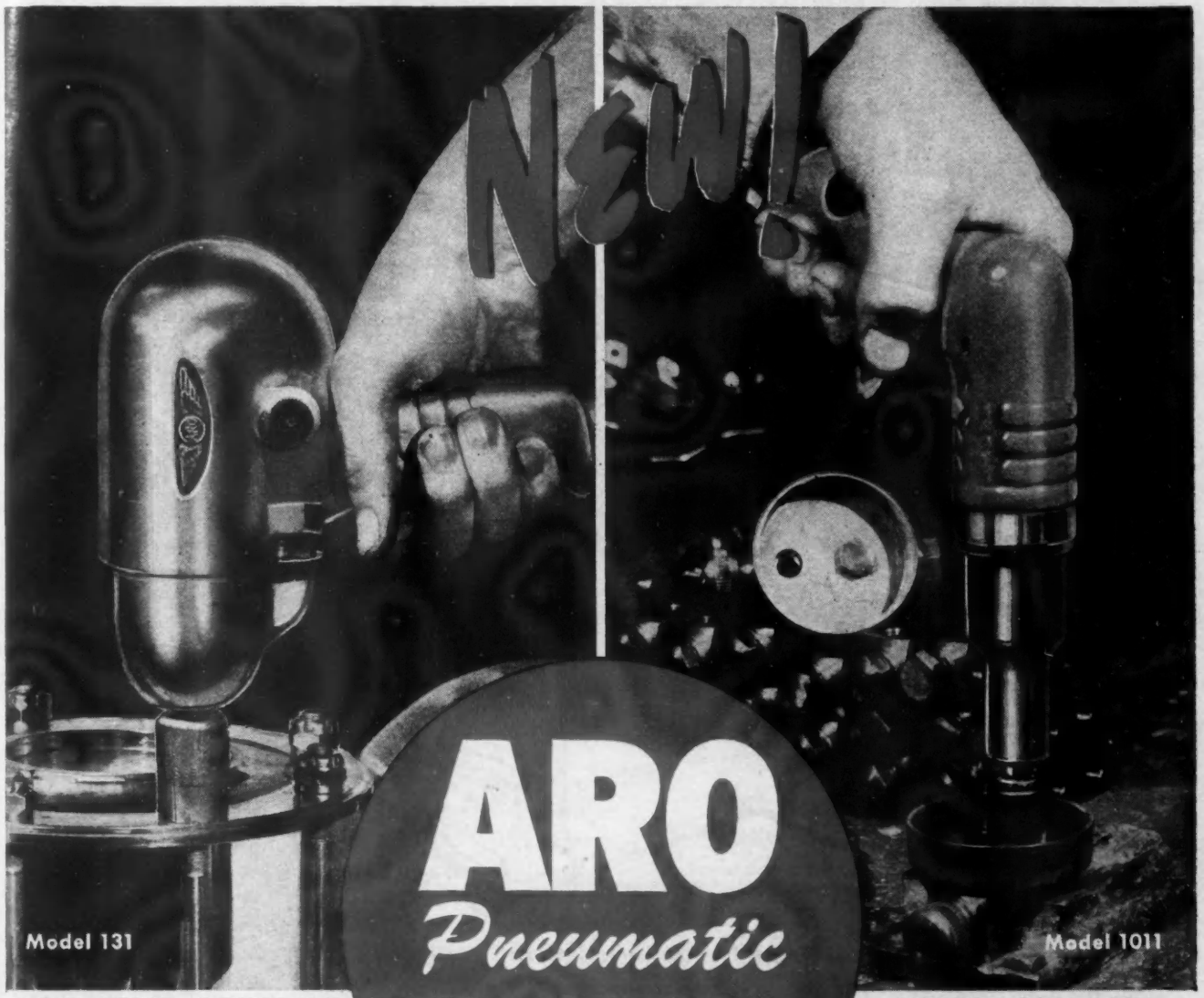
Treat Bearings Right! They're in the Fight!

1. Use only neutral mineral lubricants.
2. When lubricating with grease, it is not advisable to have the housing more than one-half to two-thirds full. Too much grease may cause generation of heat faster than it can be dissipated by the surrounding housing.
3. Do not remove bearings from wrapping until ready to use. Store in a dry place.

BCA

RADIAL • ANGULAR CONTACT • THRUST

BALL BEARINGS



ARO *Pneumatic* IMPACT TOOLS

FOR NUT SETTING OR SCREW DRIVING

WITH SIMPLE TORQUE CONTROL

REVOLUTIONARY NEW, SIMPLE IMPACT MECHANISM

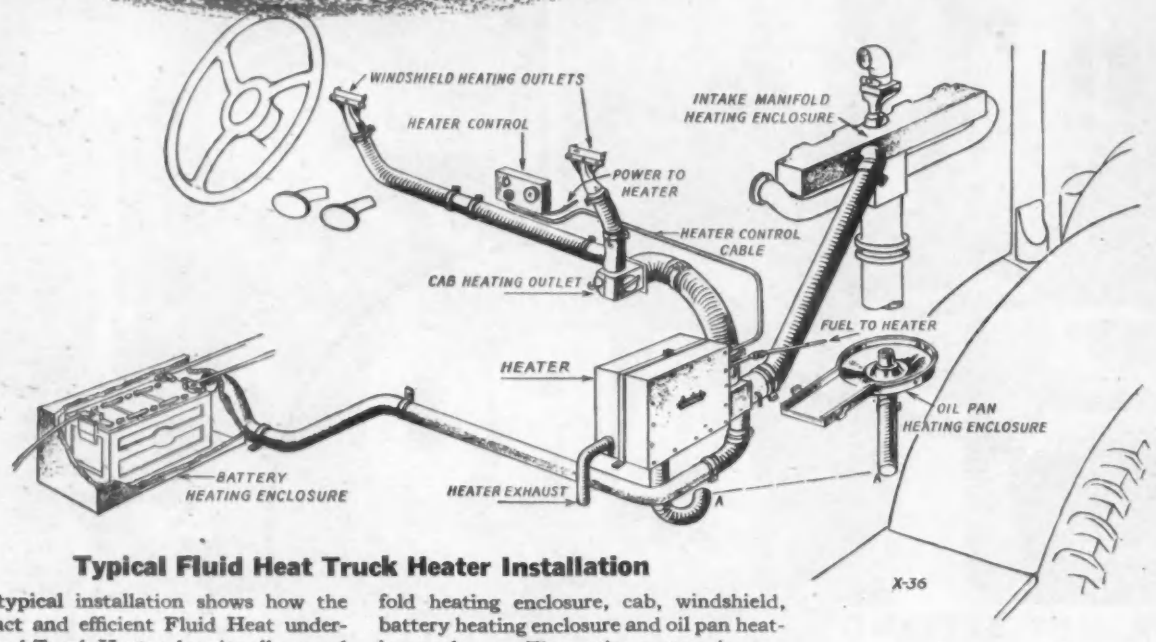
● Now for the first time you can set nuts and drive screws rapidly and accurately without stretching, stripping or "burning"... made possible with the new ARO impact mechanism with CONTROLLED TORQUE.

Backed by years of testing, proving and perfecting, this amazingly simple mechanism has only four moving parts... dispensing entirely with clutch jaws, springs, adjustment nuts and screws.

Pneumatic powered... light weight... ruggedly built. For greater speed, longer life, less fatigue, lower maintenance costs and higher efficiency... specify ARO impact tools... available in models up to 3/8" capacity. Write for new catalog No. 44. The Aro Equipment Corporation, Bryan, Ohio.

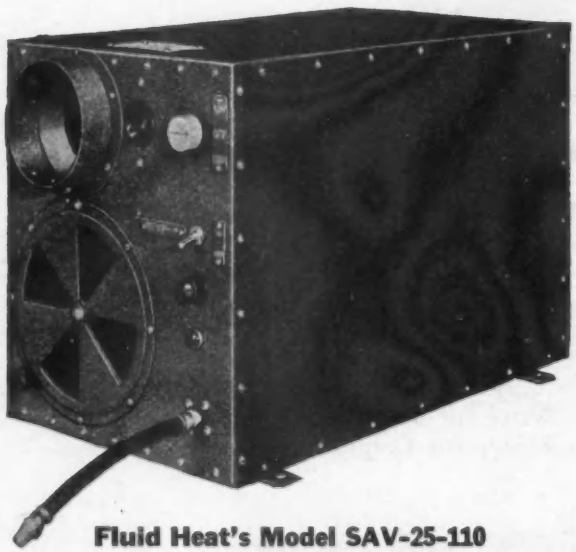
THE ARO EQUIP. CORP. PNEUMATIC ARO TOOLS BRYAN, OHIO

fluid heat TRUCK HEATERS UTILIZE



Typical Fluid Heat Truck Heater Installation

This typical installation shows how the compact and efficient Fluid Heat under-the-hood Truck Heater does its all-around job. Heat goes by ducts to the intake manifold heating enclosure, cab, windshield, battery heating enclosure and oil pan heating enclosure. The entire system is controlled by a switch on the dash.



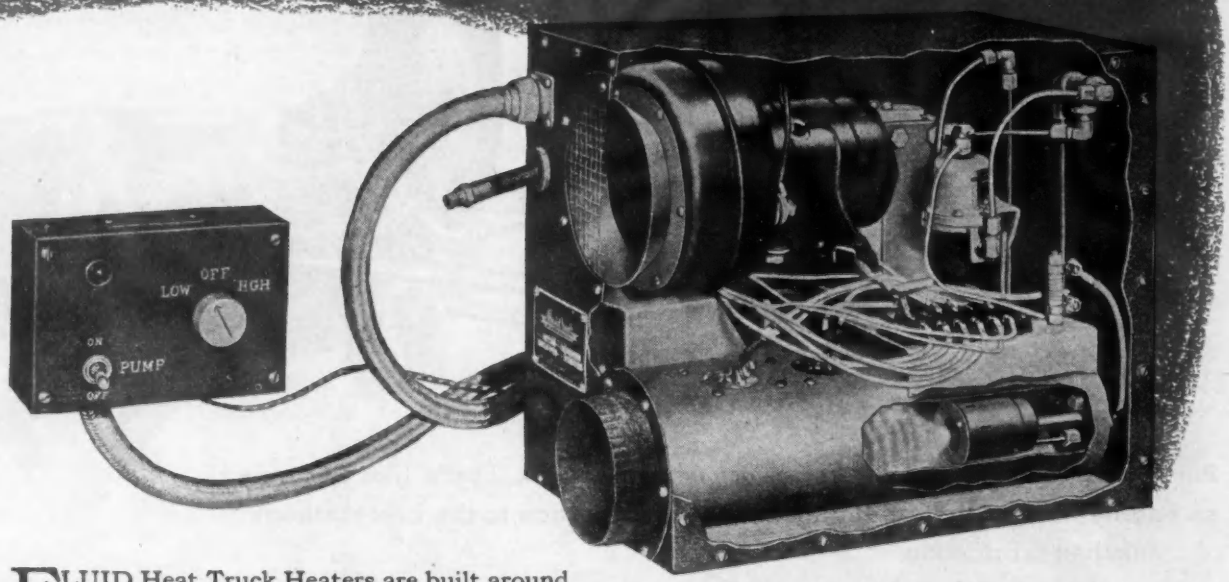
Fluid Heat's Model SAV-25-110

This model illustrates the flexibility of Fluid Heat's heat engineering know-how. Designed by request for use in trailers housing mobile laboratories, it operates on 110 A. C. and delivers 25,000 BTU per hour. Fuel is drawn directly from the tank of the vehicle. Dimensions are $17\frac{15}{16}$ by $10\frac{1}{4}$ by $12\frac{1}{16}$ inches.

Fluid Heat's Model SAH-15T

Designed for trailer and cargo-space heating, this model has an output of 15,000 BTU per hour and has a convenient hand-replenished fuel tank compactly built onto the top. Built-on tank makes the heater a completely independent, self-contained unit, permitting uncoupling of trailer without fussing with fuel lines.

NEW COMBUSTION PROCESS



Fluid Heat's New Model SAH-20 "Under-the-Hood" Truck Heater

This heater has a maximum output of 20,000 BTU per hour, yet weighs only 21 pounds, fits easily under the hood of any truck. Overall dimensions are 7¼ inches wide, 10½ inches high, 12 inches long. To insure clearance, heater can be placed in almost any position. Pump enclosed in the unit draws fuel direct from the truck's fuel tank. All models operate on 6, 12 or 24 volts D. C. or 110 volts A. C. Model SAH-40, not shown on these pages because it is identical in design, delivers 40,000 BTU per hour. It is 13 inches by 10½ inches by 19 inches, weighs 40 lbs.

FLUID Heat Truck Heaters are built around a new heating principle of special advantage in truck heating. Each Fluid Heat Truck Heater employs a vapor-entraining process utilizing preheated combustion air. This process accomplishes combustion with an unusually low pressure drop, permitting operation at low combustion air pressures and resulting in small power load. The process produces a completely suspended fire and therefore gives freedom from lead oxide formation. Flame retention is so positive that flame characteristics are the same under all atmospheric conditions.

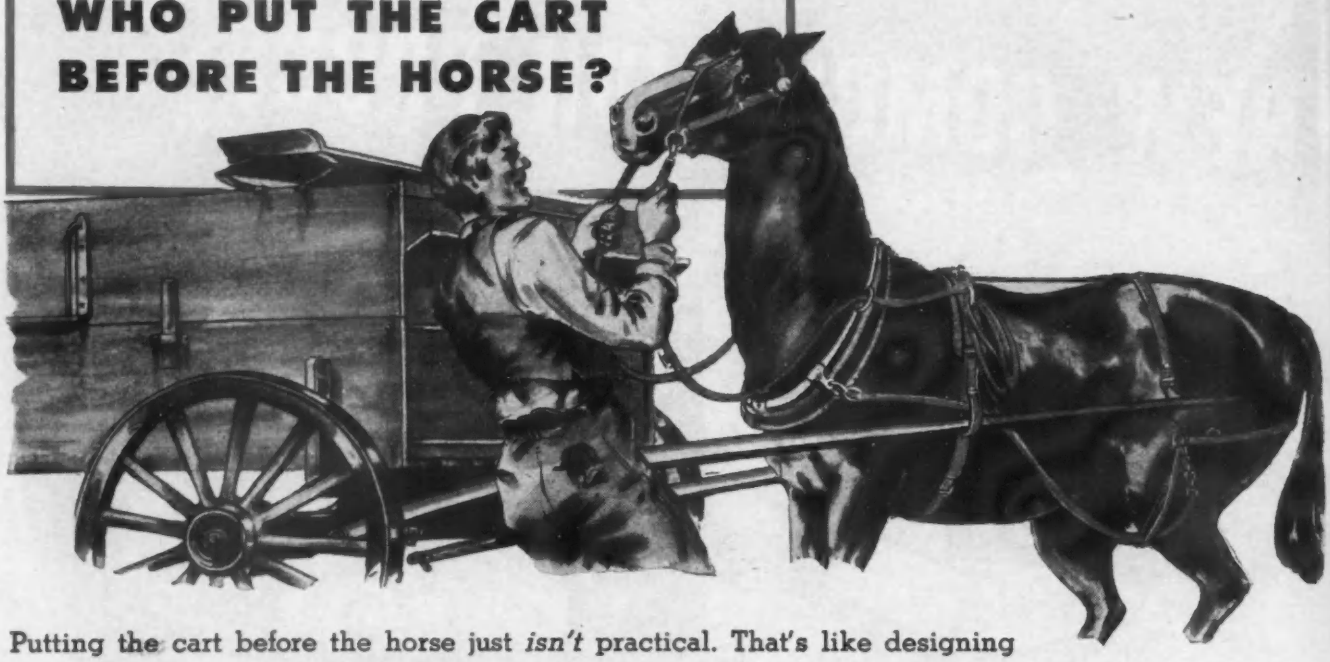
Fluid Heat's new truck heaters are compact, light, and economical. The operating control is at the heater or from a remote location. Models for trailer and cargo-space heating are available, as well as adaptations for passenger cars. For dimensions and operation details, see illustrations opposite. These heaters are a new development in automotive heating.

Fluid Heat has, for sixteen years, pioneered in the development and manufacture of automatic combustion and heat transfer equipment. Those years of heat engineering know-how are built into each light, compact, economical Fluid Heat Truck Heater. You'll want Fluid Heat Truck Heaters on the trucks, trailers or cars you design, build or equip. Write for full information on this new heating achievement.

FLUID HEAT DIVISION
Anchor Post Fence Co.
6760 Eastern Ave., Baltimore 24, Md.

fluid heat
TRUCK HEATERS

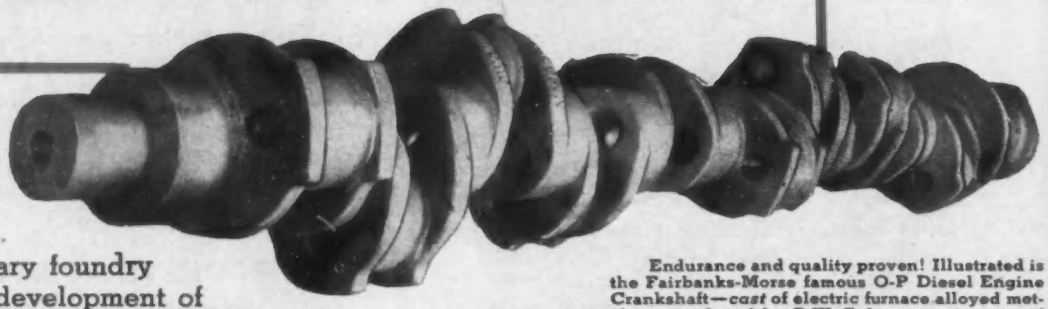
REMEMBER THE MAN WHO PUT THE CART BEFORE THE HORSE?



Putting the cart before the horse just *isn't* practical. That's like designing an engine without first giving thorough consideration to the best methods of crankshaft fabrication.

The *casting* of crankshafts is unquestionably the outstanding modern process because it eliminates the restrictions upon design that are inherent in other manufacturing methods. Consider the *casting* of *your* crankshafts . . . *that* is the practical procedure.

C.W.C. *Cast* CRANKSHAFTS PERMIT ENGINEERING POSSIBILITIES HERETOFORE BELIEVED IMPOSSIBLE!



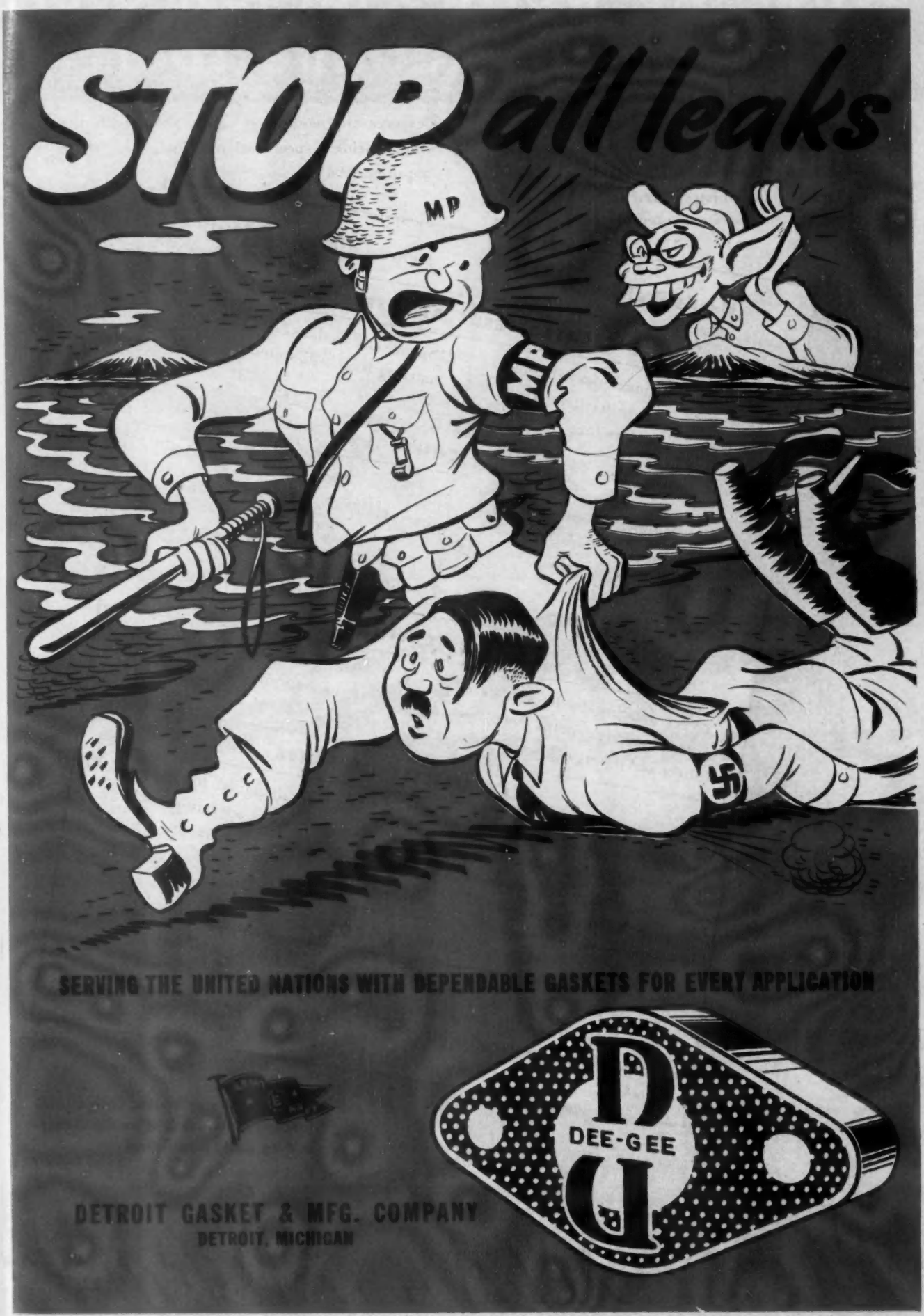
Endurance and quality proven! Illustrated is the Fairbanks-Morse famous O-P Diesel Engine Crankshaft—*cast* of electric furnace alloyed metals . . . produced by C.W.C. for over nine years!

C.W.C.'s revolutionary foundry practice plus their development of new electric furnace alloyed metals provide superior physical properties attainable through no other process. C.W.C. *cast* crankshafts definitely assure exceptional resistance to wear, distortion, or other causes of failure in service. They offer you every advantage in flexibility of design and excellence of quality. Consult our engineers about C.W.C. *cast* crankshafts. There is no obligation . . . write today!

CAMPBELL, WYANT & CANNON FOUNDRY CO.
MUSKEGON, MICHIGAN

CAMPBELL, WYANT & CANNON FOUNDRIES

- MUSKEGON, MICHIGAN
  - Henry Street Plant
  - Sanford Street Plant
  - C. W. C. Crankshaft Corp.
- SOUTH HAVEN, MICHIGAN
  - National Motor Castings Co.
- LANSING, MICHIGAN
  - Centrifugal Fusing Co.
- BETTENDORF, IOWA
  - Ordnance Steel Foundry Co.


STOP all leaks
MP
MP
SERVING THE UNITED NATIONS WITH DEPENDABLE GASKETS FOR EVERY APPLICATION
DEE-GEE
DETROIT GASKET & MFG. COMPANY
DETROIT, MICHIGAN

What the world's largest user says about Machine Tools

A manufacturer whose postwar plans call for a hundred thousand machine tools knows what he wants —what kind of machines will best handle his work. And he has told industry about it!

Here are summarized some of the important features this company wants, along with the Acme-Gridley specifications which meet these requirements.

User's Preference	Acme-Gridley Feature
INCREASED FEEDS AND SPEEDS	
More powerful machines to handle new developments in cutting tools and super-speed milling.	Speeds and feeds as fast as modern cutting tools will stand.
ELECTRIC CONTROLS	
Must be properly located, accessible, protected against dirt and damage, and dependable.	Namco Snap-Lock heavy duty Station Control and Limit Switches meet the most exacting military and industrial safety and life requirements.
LUBRICATION	
Every bearing to be lubricated from a central sump. Accessible filters and piping of adequate size.	Central lubrication and coolant systems conform to modern, accepted practices.
ACCESSIBILITY OF PARTS	
Ability to get at all parts quickly without taking entire machine apart, much more important than streamlined appearance.	Machines designed for complete accessibility of operating, tooling, service and adjustment.
CHIP DISPOSAL	
Want wider space between machine ways, with quick chip disposal and separation from coolant.	Entire tooling and cutting area open from both sides, easy to keep clear, and automatic conveyor disposal.

Correspondence invited with manufacturers interested in modern, cost-cutting parts production.

THE NATIONAL ACME CO.

170 EAST 131ST STREET • CLEVELAND 8, OHIO

ACME-GRIDLEY 4-6 AND 8 SPINDLE BAR AND CHUCKING AUTOMATICS • SINGLE SPINDLE AUTOMATICS • AUTOMATIC THREADING DIES AND TAPS
THE CHRONOLOG • LIMIT, MOTOR STARTER AND CONTROL STATION SWITCHES • SOLENOIDS • CENTRIFUGES • CONTRACT MANUFACTURING

THE *Rocket Plane* TAKES TO THE SKIES

For years designers of high-speed aircraft have dreamed of the day when planes would shed their "props" and be driven, instead, by jet propulsion.

Today, at Bell Aircraft, the rocket plane is no longer a dream but a reality. It has emerged from the drawing-board stage and is now in production. A plane that flies at such speeds and altitudes, and with such startling maneuverability, that its test flights caused engineers to say that the jet plane had opened a new chapter in aviation history.

Mechanical features of Bell's new "rocket ship" are naturally shrouded in wartime secrecy. It can be said, however, that many of the parts made by Bell—and many of the parts supplied by other manufacturers—are of Bethlehem alloy steels. As a matter of fact, through the years of its growth to its present high position, the Bell organization has made Bethlehem Steel one of its chief sources of supply.

Alloy steels are playing a vital part in the development of newer and faster planes, and in hundreds of other products essential to the war effort. A tremendous amount of research on wartime steels has been done by Bethlehem metallurgists—research that has included the most exhaustive laboratory tests. If you have an alloy-steel problem involving analyses, properties, heat treating, or applications, the data resulting from this research are at your service. Write Bethlehem Steel Company, Bethlehem, Pa.

BETHLEHEM STEEL COMPANY, Bethlehem, Pa.
Bethlehem Steel Export Corporation, New York City

★ ★ BETHLEHEM STEEL ★ ★

POWER TO WIN

It would be very difficult, indeed, to find a fighting American pilot whose primary training was not acquired with Continental Red Seal Engines.

One good reason why is that Continental made the first commercial engines for smaller aircraft. In fact, Continental pioneered the light aircraft industry and is largely responsible for the success of that industry.

Naturally, this outstanding record is a matter of pride, but it is also a reminder of how these famous Red Seal Engines will perform for civilization after the war.

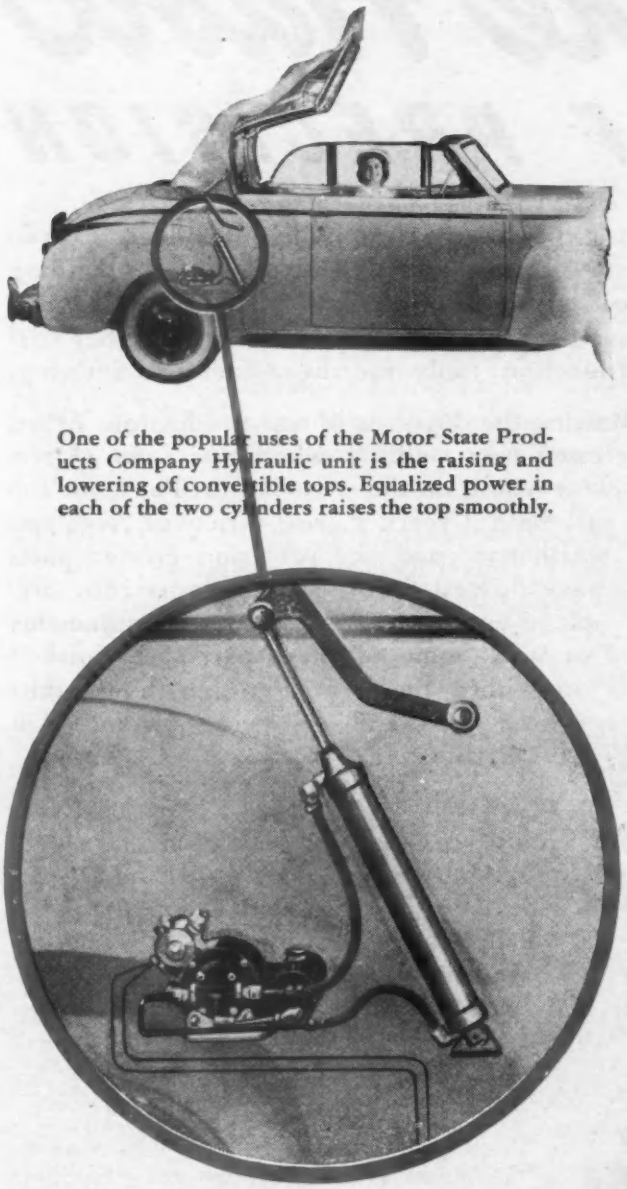
YOUR DOLLARS ARE POWER, TOO! BUY WAR BONDS AND KEEP THEM

ARMY E NAVY

Awarded to the Detroit and Muskegon Plants of Continental Motors for High Achievement.

Continental Motors Corporation
Aircraft Engine Division
MUSKEGON, MICHIGAN

Do you have a SERVO POWER PROBLEM ?



One of the popular uses of the Motor State Products Company Hydraulic unit is the raising and lowering of convertible tops. Equalized power in each of the two cylinders raises the top smoothly.

Equalized power is exerted to each side through interconnected hydraulic cylinders, making it impossible to bind, twist, or bend the top. Synchronized lifting effort is assured at all times.

The by-pass valve located in the hydraulic channels within the pump may be adjusted to operate at a definite pre-determined pressure. This safety feature allows the top to be stopped by hand at any point in the travel without building up and increasing pressure. Damage by overrun either in extending or lowering the top is impossible.

When the power is off, the interconnecting valve connects both ends of the cylinders. This feature makes it possible to operate the top manually, without damage to mechanical parts.

MOTOR STATE HYDRAULIC POWER UNITS ARE ENGINEERED FOR INSTALLATIONS WHERE:

1. Finger-Tip Remote Control of smooth, positive action at constant pre-set speeds and pressures and definite limits of power are required.
2. Ease of Installation and adaptability to body or product design is an important factor.
3. An atmospherically sealed, trouble-free unit delivering a synchronized actuating force to one or more working points is essential.

It's Time Now to Think of Postwar Schedules

Like everyone else, the Motor State Products Co. is pretty busy these days. The time is coming, however, when we all shall turn back to peacetime manufacturing. And when we do there's likely to be considerable hurry to get plans and schedules organized—

The time to do this planning is right now, whenever there are a few minutes that won't rob the war effort. Our engineers—specialists in the design and application of Hydraulic Power Units—work on that principle, and we are glad to offer, on this limited basis, a consulting service on postwar Hydraulic Power Applications.

Contact Motor State Products Company at 2-257 General Motors Building, Detroit 2, Michigan.

MOTOR STATE PRODUCTS COMPANY

YPSILANTI, MICHIGAN

ORIGINATORS AND MANUFACTURERS OF THE PUSH-BUTTON CONVERTIBLE TOP

The Habit OF PRECISION

● Long before the war, Allied Products Corporation formed the habit of precision—in building sheet metal dies, intricate jigs and fixtures, R-B interchangeable punches and dies and other vital production tools for the automotive industry.

Meeting the demands of war production, Allied created new facilities where *the habit of precision* would do the most good. Thus, for the past several years, a great variety of large and small, hardened and precision ground parts have flowed from Allied plants into airplane engines, guns and other implements of war. Some of these parts are finished to within limits of two ten-thousandths of an inch and are being produced in great volume.

When peace comes, a large part of this "pool of precision"—skilled craftsmen, mass production equipment and practical experience — will be available to manufacturers of consumer goods. If you are looking for a dependable source of supply, let's get together now. At Allied, precision and economy have advanced hand in hand.

• • •

"IT'S AN ALLIED PRODUCT!" . . . Allied Products Corporation and its divisions, Richard Brothers and Victor-Peninsular, in Detroit and Hillsdale, Michigan, also make: Steam-heated plastic molds; cap screws; cold forged parts; and other special products.

ARMY E NAVY

All Four Plants Have Added Stars To Their Army-Navy "E" Pennants

BUY MORE WAR BONDS

ALLIED PRODUCTS CORPORATION

Executive Offices:
4646 Lawton Avenue
Detroit 8, Michigan

"That Job is DONE!"

THE FUEL LINE ON THIS TRUCK WILL LAST!

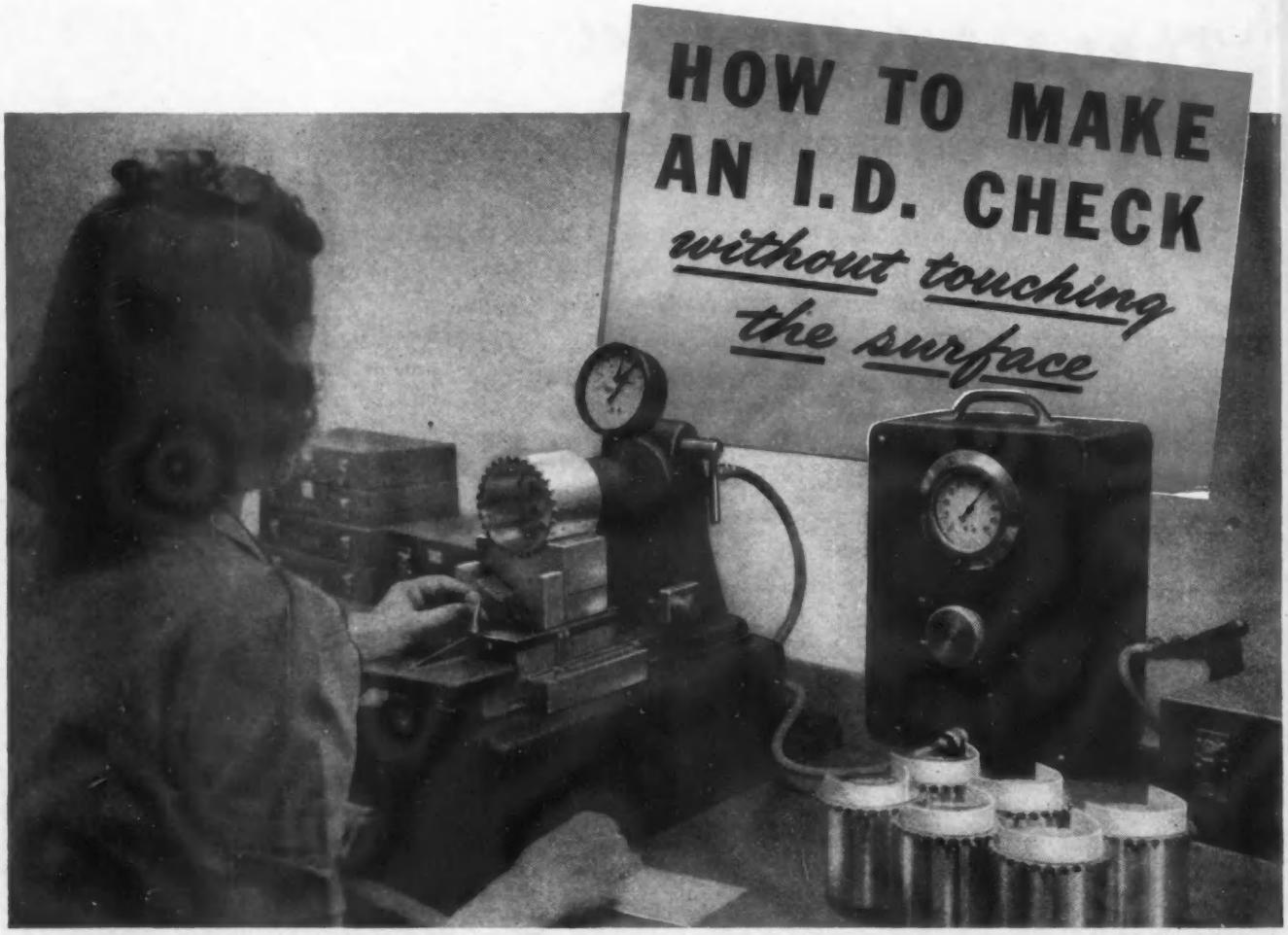
—and last for a long, long time to come. For the fuel line is TITEFLEX — and no other fuel line made can give such long, trouble-free service.

Titeflex is metal — *all* metal. It isn't affected by the corrosive action of oil, gas, or grease . . . can't be damaged by high engine temperatures . . . takes hard treatment and vibration right in its stride, thanks to the flexible construction and "woven-in-place" metal braiding.

With heavy trucks and buses representing one of the country's most critical shortages, many manufacturers realize that one solution is to make each vehicle more efficient, more productive. Accordingly, they specify Titeflex throughout — for every oil, gas, or air line connection. And in the same way, Titeflex has become the standard replacement wherever operators and servicemen are concerned with "keeping 'em rolling" and building goodwill and profits for Post-War operation.

May we give you more information on Titeflex *all metal* flexible tubing — without obligation?

TITEFLEX, INC.
507 Frelinghuysen Avenue
Newark 5, New Jersey



This Pratt & Whitney Air-O-Limit Internal Comparator avoids actual contact . . . eliminates danger of scratches or marrings of fine finished surfaces . . . gives instant, accurate readings that split "tenths" . . . speeds up I.D. inspection rate.

• • •

It was a tough problem. An airplane engine manufacturer needed a safe, sure way to inspect the critical I.D. of master-rod bearings. Ordinary gaging methods would touch the soft lead-indium plated inner surface . . . produce scratches that would spoil it for use.

The manufacturer asked Pratt & Whitney engineers, "Have you the answer?"

"No, but we'll find one." Result: the Air-O-Limit Internal Comparator . . . extremely simple in construction and operation . . . but it took the accumulated years of P&W "know-how" and experience and skill to produce it quickly.

Here's how it works. The bearing to be inspected is placed on a sliding V-block mounting and slipped over the gaging spindle . . . there is a slight clearance so that *it does not actually touch.* This spindle has two tiny opposite nozzles through which compressed air is forced. The amount of back pressure caused by limiting the discharge of air through the nozzles is registered on a precision pressure indicator calibrated to read in ten-thousandths of an inch. Size, roundness, and taper are unerringly recorded.

This is the highly successful Air-O-Limit Bearing Gage. Other Air-O-Limit models use the same "air principle" but omit the non-touching feature. The piece slips on the spindle and rests on a chrome-plated surface. Hundreds of this type are at work inspecting fine tolerance parts. They require practically no upkeep or servicing . . . are designed for long wear.

One more typical Pratt & Whitney contribution to the speeding up of America's mighty war production . . . one more contribution to peacetime mass production. Ask for information.

PRATT & WHITNEY

Division Niles-Bement-Pond Company

WEST HARTFORD, CONNECTICUT, U. S. A.

OWI Photo by Palmer in an Allegheny Ludlum plant

To this Flywheel, Many a Bomber

OWES ITS OWN ABILITY TO FLY

At your Service . . .

ALLEGHENY LUDLUM'S FILM LIBRARY

Instructional films on tool and stainless steels—some in full color, all with sound—available for free showings by companies, trade & industrial groups, student training courses, technical schools and colleges, etc., upon request.

WRITE FOR DETAILS

ADDRESS DEPT. AI-25

WITHOUT special alloy steels, no modern bomber would fly . . . in fact, there are more of these materials in the big planes than any other single ingredient, a fact not so commonly understood.

Many of these special steels—electrical, corrosion and heat-resisting, valve and nitriding—first passed over the big breakdown mills in Allegheny Ludlum plants. Even more particularly, many of them were developments of our own research, and all of them are raw materials of the greatest portent for the future.

Special steels have eloquently demonstrated their ability to do for a product—perhaps *your* product—what ordinary materials cannot do. Let our Technical Staff help you to fit these tailor-made steels to your needs.

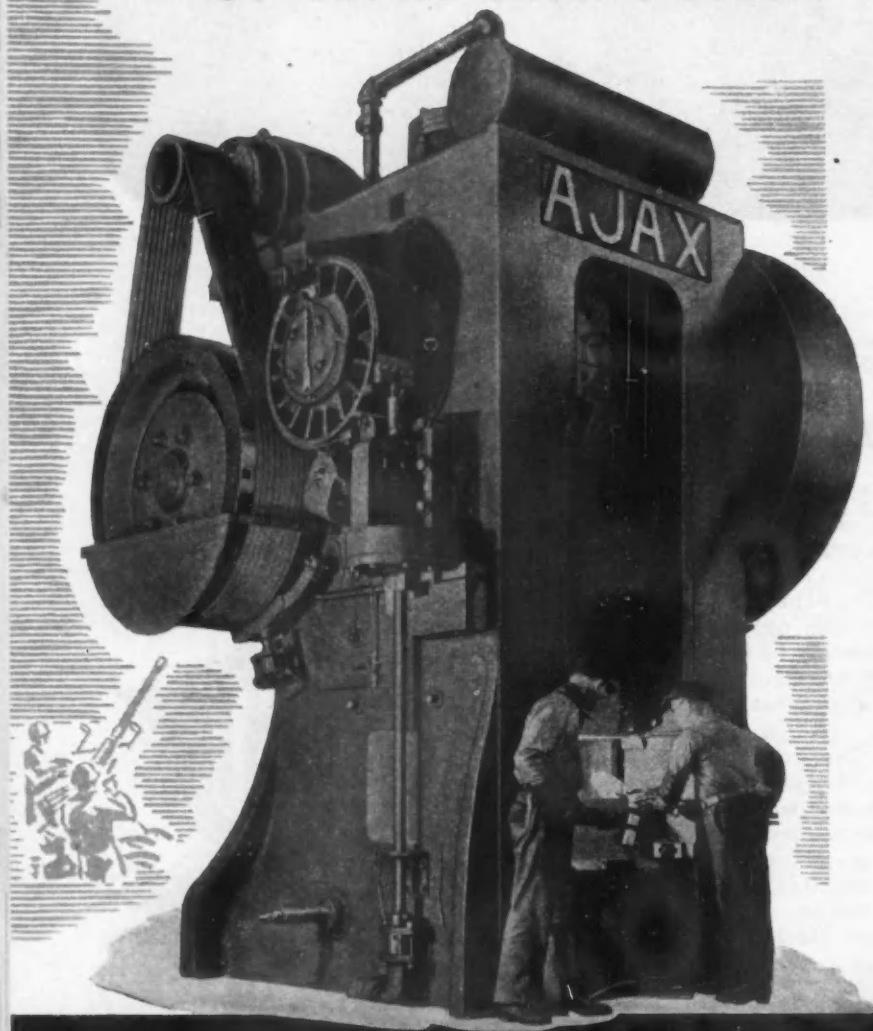
Allegheny Ludlum
STEEL CORPORATION
BRACKENRIDGE, PENNSYLVANIA

Allegheny Stainless also handled by all Joseph T. Ryerson & Son, Inc. warehouses

W&D . . . B-9334

Industry's Striking Power

for Forging the Products of WAR and PEACE



Today, in forge shops all over the country AJAX Forging Machines and Forging Presses are performing a vital role in the high speed production of material for war, such as parts for ships, guns, tanks, airplanes, bombs and shells—adding their full share to industry's all out effort toward speeding victory. And when that goal has been attained and the requirements for war are curtailed, with merely changing of the dies these same machines and presses will produce, economically at high production rates, accurately forged parts for automobiles, refrigerators, farm implements, railroad cars, and many, many more products to immediately meet the requirements of a new and greater peacetime economy.

Write for Descriptive Bulletins.

THE AJAX MANUFACTURING COMPANY
EUCLID BRANCH P. O. CLEVELAND, OHIO
621 MARQUETTE BUILDING • CHICAGO, ILLINOIS

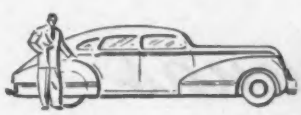
Illustration is from Inland poster showing operation in the production of the Inland-made Fire Extinguisher Horn

The Inland-made Fire Extinguisher Horn is an important part of the fire extinguisher used on U. S. Naval Ships. Its development and production in record-breaking time is a striking example of Inland's engineering resourcefulness in the field of laminated plastics.

Early in 1943, Inland was asked to apply its experience in the development of plastic Helmet Liners to the production of an Extinguisher Horn. 60 days thereafter Inland started production on improved Extinguisher Horns which were twice as strong as the Navy's requirements. Since that time Inland improvements have made the horns still sturdier, eliminated a finishing operation, increased their utility and reduced their cost.

The Fire Extinguisher Horn is one of many Inland products for Victory, which are helping Americans carry the attack to the enemy everywhere.

INLAND MANUFACTURING DIVISION, *General Motors Corporation,* DAYTON, OHIO



INLAND INLAND *Manufacturing*
RUBBER, METAL, PLASTICS

Inland Products for Victory include Carbines, Tank Tracks, Gun Sights, Helmet Liners, Extinguisher Horns, and Rubber, Synthetic Rubber and Metal Parts for Tanks, Aircraft, Submarine Chasers, Torpedo Boats, Artillery Lighters and Landing Craft.

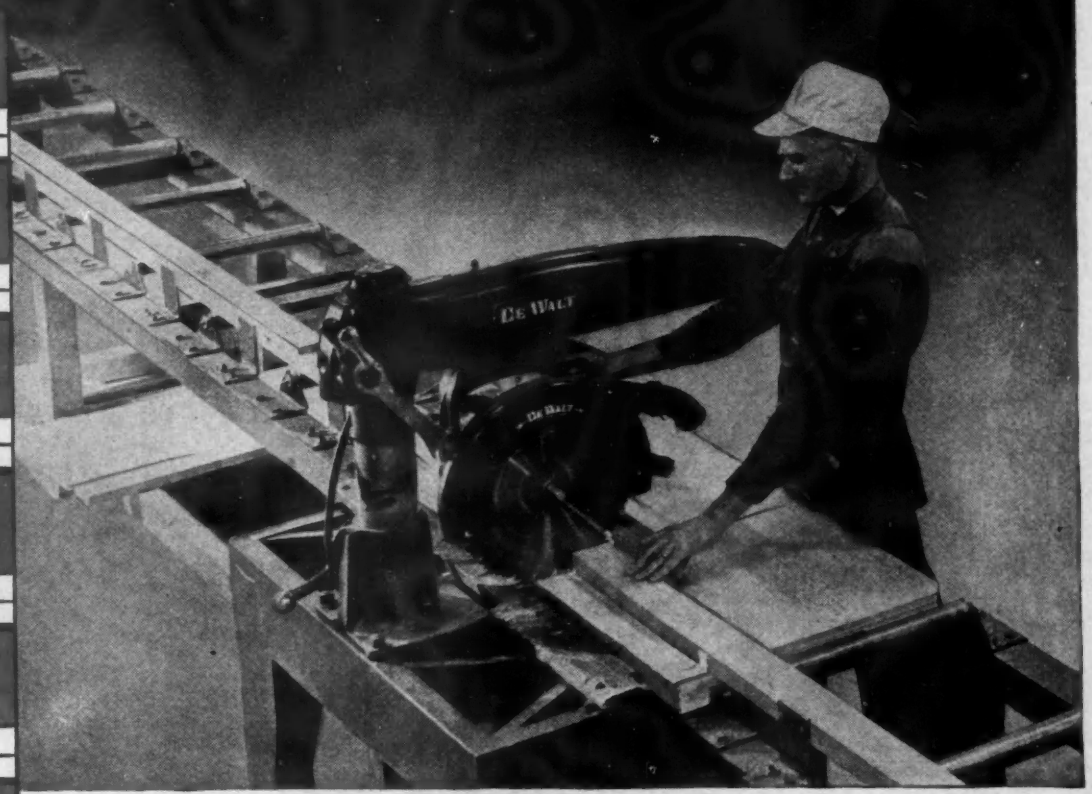
Yesterday and TODAY

The Army-Navy Production Award for outstanding achievement in producing vitally important materials essential to the war effort will be an added incentive to the management and employees of **WARD PRODUCTS CORPORATION** to keep producing more and better equipment for the men who are doing the fighting. While yesterday **WARD** Antennas were accessories for pleasure, today they are implements of War.

WARD *Antennas*

THE WARD PRODUCTS CORPORATION, 1523 EAST 45TH STREET, CLEVELAND, OHIO

DE WALT ANSWERS INDUSTRY'S NEED FOR A VERSATILE ALL-PURPOSE CUT-OFF SAW!



Here's a DeWalt that you can use for many jobs anywhere in your plant *now!*

DeWalt is the ALL-PURPOSE machine that can be changed quickly, as required, from a straight-line cut-off saw—to miter saw—to rip saw—to dado machine—to shaper—or other operations that can be made with circular cutting tools.

Investigate DeWalt. Install a DeWalt. Reduce cutting costs. Simplify materials handling. Eliminate waste. Save time. DeWalt is available in models ranging from ½ H.P. to 10 H.P. Send coupon below for full information.

DE WALT

Makes Every Cut Possible With a Circular Saw

DeWALT PRODUCTS CORPORATION
5806 Fountain Avenue, Lancaster, Penna.
Please send me information on your complete line.

Name.....

Address..... State.....

City.....

We're on our way...

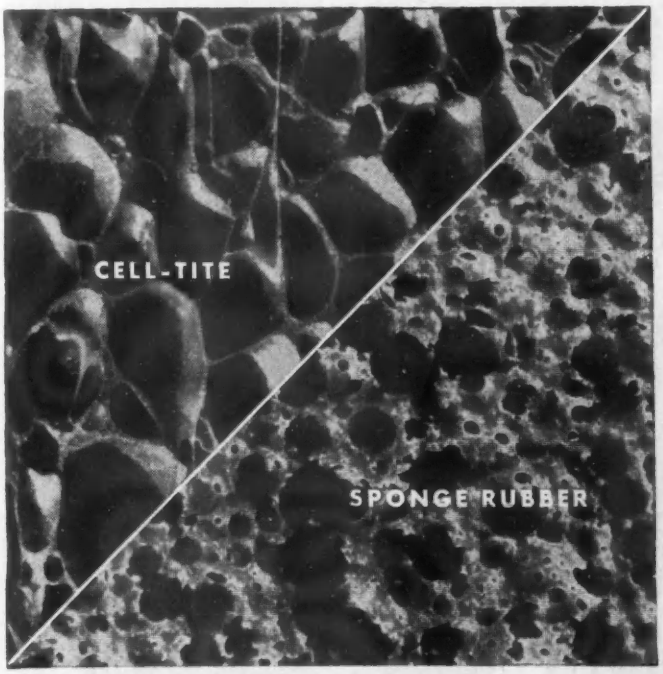
We are doing our part with master production in Diesel, steam and other engines of war and peace.

BUT KEEP THAT GUARD UP!

GENERAL MACHINERY CORPORATION

HAMILTON, OHIO

THE NILES TOOL WORKS CO. • THE HOOVEN, OWENS, RENTSCHLER CO. • GENERAL MACHINERY ORDNANCE CORPORATION



CELLULAR RUBBER

THIS VERSATILE MATERIAL SEALS AGAINST MOISTURE, DEADENS SOUND, DAMPENS VIBRATION, INSULATES, AND MAKES PRODUCTS LIGHTER.

Photographs at left (12 diameters) show cross sections of two basic types of cellular rubber. Popular before the war, their wartime record points to even wider usefulness in the improvement of many products for peace.

Sponge and Cell-Tite Rubber are made by expanding natural or synthetic rubber to produce lightweight, resilient materials that form effective barriers against heat, cold, shock, sound, vibration, electricity.

Cell-Tite is non-absorbent — cells are individual, non-connecting, filled with inert gases. Sponge rubber is *absorbent;* cells interconnect.

Cell-Tite may be *hardened* in the process of manufacture. Reputed to be the strongest structural material for its weight commercially produced, Cell-Tite Hard is thermoplastic; may be reshaped after manufacture.

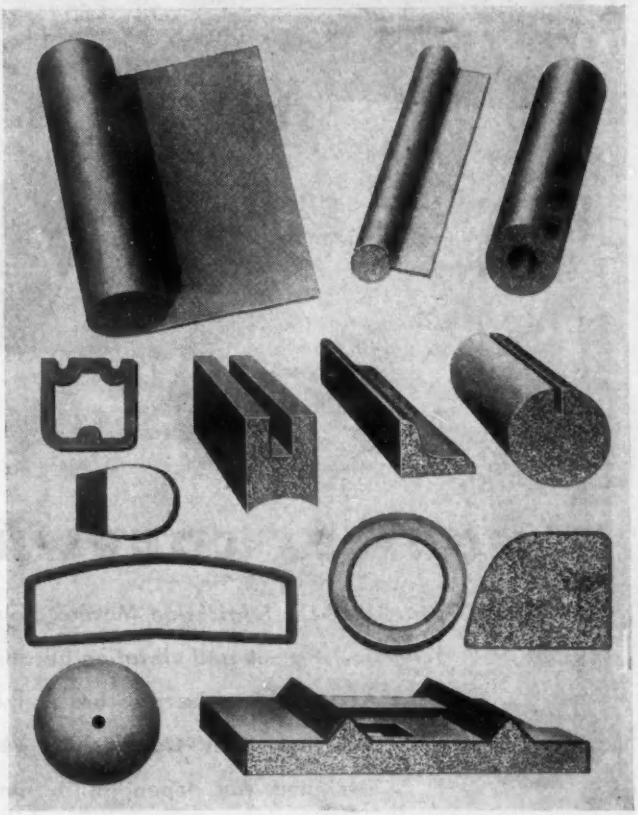
We compound cellular rubbers to meet your exact need and supply you with sheets, strips, slabs, cord or tubing, pads, molded shapes or die-cut pieces.

This company began research and experimentation with cellular rubber in 1923. Prior to wartime restrictions, two of its products — Sponge Rubber and Cell-Tite* — had won widespread use in automobiles, refrigerators and other products in which insulation, sound deadening and vibration elimination were essential. This demand established us as the world's largest producer of this type of material.

Production capacity was expanded to meet war demands; hundreds of formulae originated to meet special requirements of war industries. Methods developed in our laboratories enable us to control cell structure, weight, tensile strength, amount of resistance to heat, chemicals, abrasion, oxidation — to compound cellular rubber in any form to meet any indicated industrial purpose.

Our technical men are ready to work with you now. Some compounds of synthetic and reclaim rubber are available for experimental work and limited civilian manufacture. Tell us your problem; if it can be solved with cellular rubber, we'll help you solve it.

*Trade Mark Registered U. S. Patent Office



SOME USES OF CELLULAR RUBBER

There are hundreds of present uses; hundreds more potential uses. Wherever metal meets metal — in auto and aircraft doors, windows, frames, — strips and formed parts of cellular rubber seal, insulate, lessen sound and vibration. Hard and soft varieties insulate refrigerators and quick-freeze units; are used in the marine industry for life-preservers, life rafts.

Cell-Title Hard is the most efficient and durable material known for flotation purposes. Dielectric properties of Cell-Tite Hard, have led to its wide use in radio and radar equipment.

Sponge Rubber Products Co.

101 Housatonic Avenue

DERBY, CONN.

MORFLEX COUPLINGS FOR MANY USES

Without lubrication **Morflex Couplings operate at top efficiency . . .** ***resist shock and vibration*** **because resilient rubber trunnion blocks are assembled under pressure in the center unit. ¶ Dust and dirt can't interrupt their trouble-free performance. ¶ Compact and quiet, designed for dependability on any type of installation. Morflex couplings combine all these features. ¶ Consult your Morse engineer.**

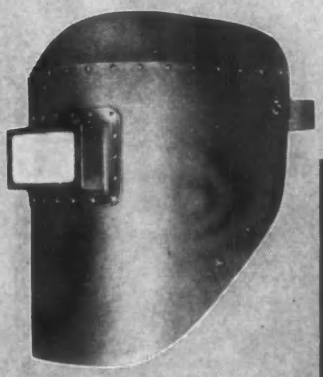
SPROCKETS CHAINS FLEXIBLE COUPLINGS CLUTCHES

MORSE *Roller and Silent* CHAINS

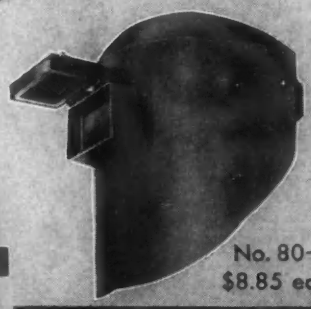
MORSE CHAIN COMPANY • ITHACA, N.Y. • DETROIT 8, MICH. • A BORG-WARNER INDUSTRY

POPULAR WELDING HELMETS

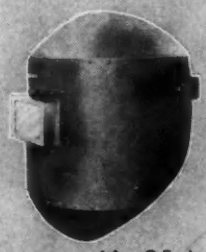
Five Styles—All Sizes



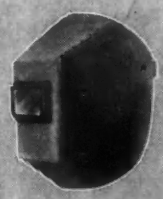
No. 45-A
$6.60 each*



No. 80-A
$8.85 each*



No. 25-A
$7.05 each*



No. 70
$3.40 each*

No. 66
$4.75 each*

These quality arc welding helmets afford a wide range of selection to meet individual preferences, as follows:

No. 45-A: Strong and leakproof, weighing only 15 oz. without lens. Made of best grade, non-warping, black vulcanized fibre. Adjustable chin rest, free-floating wide range headgear.

No. 80-A LIFT-FRONT HELMET: Same as No. 45-A, except that it has a lift-front glass holder. Operator may observe work without lifting helmet. Space is provided for extra clear glass. Weight, about 21 oz. without lens.

No. 25-A: Compact, form fitting, and well ventilated. Especially designed for close-quarter use. Made of best grade, non-warping, black vulcanized fibre. Adjustable chin rest, free floating wide range headgear. Weight, 16 oz. without lens.

No. 70: A lower-priced helmet that is serviceable, well-made, and leakproof. Made of good quality, non-warping, black vulcanized fibre. Adjustable headgear and chin rest. Weight, 14 oz. without lens.

No. 66: A moderately priced, leakproof helmet. Leather sweatband, sliding type adjustable headgear. Streamlined design makes it ideal in close quarters. Weight, about 19 oz. without lens.

**Prices do not include colored plate and cover plate. Prices given above are subject to discount in lots of 12 or more.*

Save Buying Time

use AIRCO'S illustrated price list of gas and arc welding supplies

This handy booklet gives prices, sizes and shipping details on Airco's comprehensive line of gas and arc welding accessories. Mail the coupon for your free copy. If you also want facts on Airco Electrodes, indicate request on the coupon.

★ BUY UNITED STATES WAR BONDS ★

AA

Air Reduction Sales Co.
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New York 17, N.Y.

Please forward as soon as possible:

☐ Airco Gas and Electric Supplies Price List.
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Name.....
Company.....
Address.....
City..... State.....

AIRCO WILSON

AIR REDUCTION

General Offices: 60 East 42nd Street, New York 17, N. Y.
In Texas: Magnolia Airco Gas Products Co. General Offices: Houston 1, Tex.
Offices in all Principal Cities

Udylite Metal Finishing Supplies are the finest available—dependable, efficient, carefully tested and approved in our own laboratories under actual plant conditions before they are offered to you.

When you buy Udylite supplies you buy a share in one of the finest staffs of engineers and electrochemists in the country. These men know metal finishing from A to Z and their combined "know-how" is at your service to solve any finishing problems you may have. They'll not only put you right but they'll keep you that way by constant check and control if you wish. *There*, is something money cannot buy. It's Udylite's plus value at no extra cost.

VISIT THE UDYLITE EXHIBIT D628–D632—NATIONAL METAL EXPOSITION—CLEVELAND

THE UDYLITE CORPORATION

1651 E. Grand Blvd., Detroit 11, Mich.

Chicago 12
1943 Walnut Street

Long Island City 1, N. Y.
11-16 44th Drive

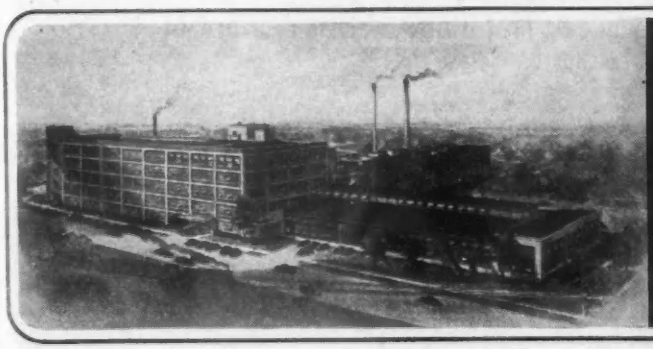
Cleveland 3
4408 Carnegie Ave.

It is also necessary to be Prepared for Peace

As long as they are needed, King-Seeley will continue to concentrate all its facilities and energy in the production of ammunition components and a variety of parts for combat vehicles, aircraft, landing barges and fire control systems.

BUT when G. H. Q. flashes the signal, this organization will, with renewed enthusiasm, resume its service to the automotive industry in the production of instruments, instrument clusters, speedometers, governors and oil filters.

Our reconversion has been carefully planned. It can be made promptly enough to prevent delays in the production of victory models in both automobiles and trucks.



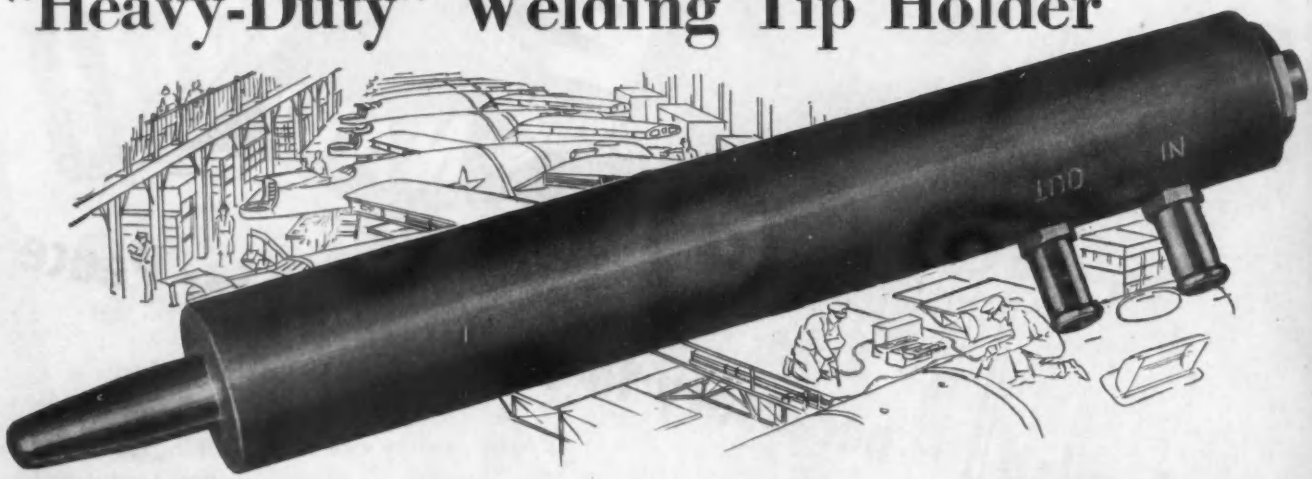
KING-SEELEY CORPORATION

ANN ARBOR MICHIGAN

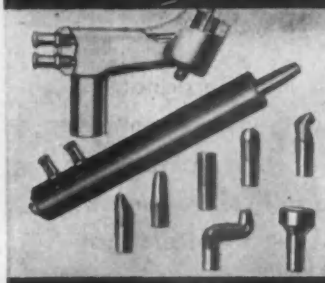
For Tough Jobs . . .

P. R. MALLORY & CO. Inc.
MALLORY

"Heavy-Duty" Welding Tip Holder



Speedier Production
Less Down Time
Better Welding
Lower Cost



SPOT WELDING TIPS AND HOLDERS

FLASH, BUTT, PROJECTION WELDING DIES

SEAM WELDING ROLLS

Today's increased production calls for resistance welding tip holders that are able to stand up under gruelling service. Mallory answers the need with a product that lives up to its name—the Mallory "Heavy-Duty" Holder.

Carrying an increased flow of water or other coolant, this streamlined, compact tip holder keeps tip temperatures down and increases welding quality and efficiency. Its single piece housing, built to protect vital interior parts, also eliminates coolant leakage troubles.

In addition, the holder features an ingenious knockout device that allows the tip to be ejected quickly by a slight hammer blow at the other end. It has a packing nut, readily accessible at the rear, for quick replacement of packing or adjustments.

The Mallory "Heavy-Duty" Resistance Welding Tip Holder is one of several especially built by Mallory for the tougher jobs of wartime. It has what it takes to stand the gaff.

To get the latest technical information on resistance welding electrodes (for ferrous or non-ferrous metals), write today for your copy of the Mallory Resistance Welding Data Book.

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

Buy War Bonds

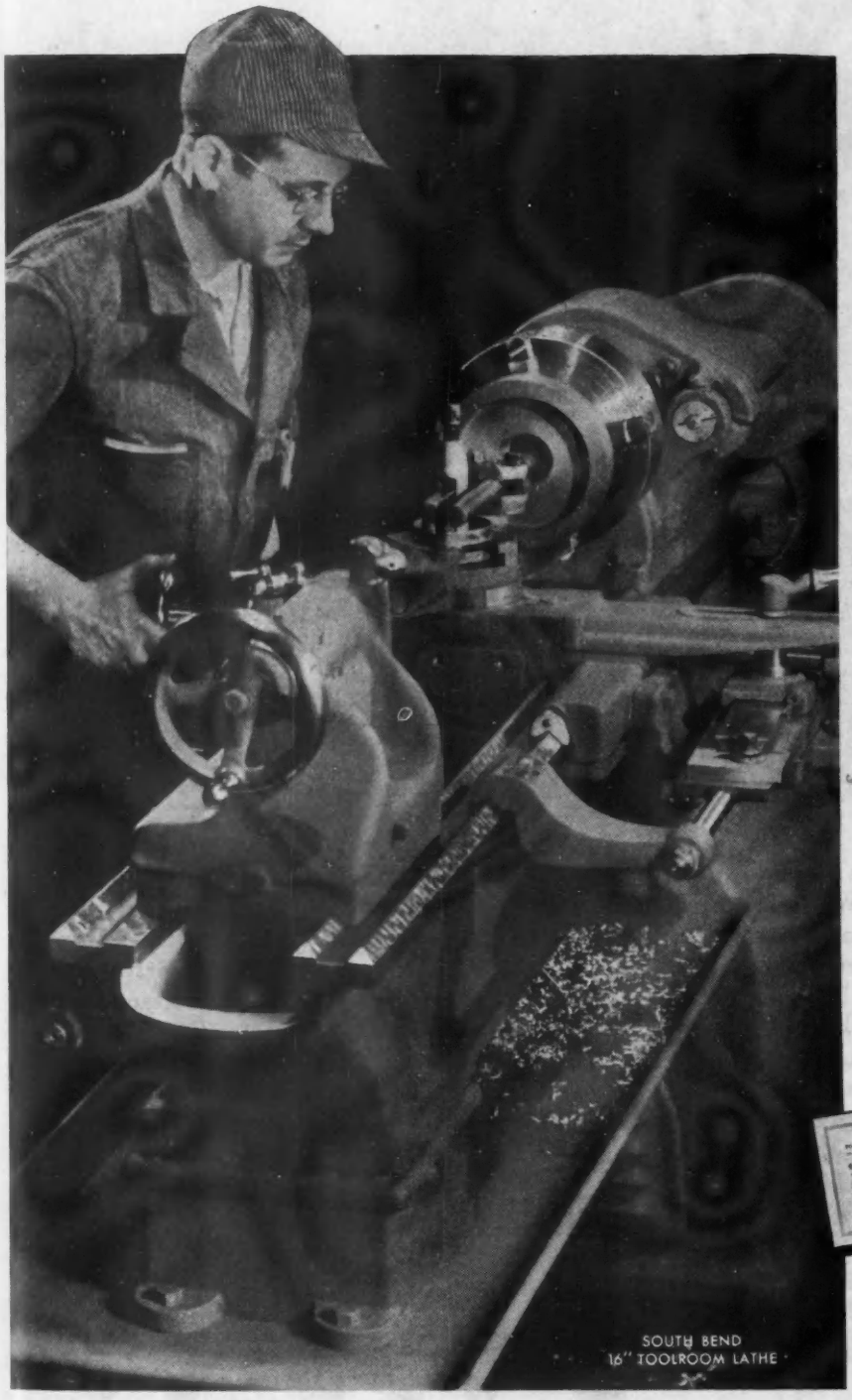
ARMY E NAVY

P. R. MALLORY & CO. Inc.
MALLORY

Standardized Resistance Welding Electrodes

PRECISION

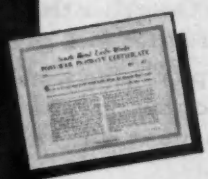
— AS VITAL IN WAR AS IN PEACE



In every theater of war South Bend Lathes are holding to their pre-war traditions for dependable precision. In the mobile machine shops of our mechanized forces they duplicate factory tolerances on intricate parts needed for emergency repairs on guns, tanks, trucks and other essential equipment. On board many of the Navy's fighting ships, where high precision is an absolute requirement, they are also depended upon for maintenance and repair of mechanical equipment. In the repair bases of the Air Forces they play an equally important part in keeping planes in service. Sometimes small South Bend Lathes are even flown to remote locations for making quick repairs on grounded planes.

In all classes of war service these lathes are doing fine precision work—not only with the armed forces but also in industry where dependable accuracy is as vital as speed and versatility in meeting war's urgent production schedules.

When civilian production is resumed South Bend precision will again prove as indispensable to peace-time industry as it is now for exacting war work. Embodying the improvements developed to meet war production requirements, South Bend Engine Lathes and Toolroom Lathes will be available, also the South Bend Precision Turret Lathes having ½" and 1" collet capacity.



POST-WAR PRIORITY PLAN

To those who cannot qualify for a war-time priority, South Bend Lathe Works offers a practical Post-War Priority Plan. You can place your order now for any South Bend Lathe. No deposit or down payment is required. We ask only that the order be placed in good faith. When civilian production is resumed, orders will be filled in the sequence established by the numbers of the Post-War Priority Certificates. Should conditions necessitate, the order may be cancelled at any time. Write now for details of this plan—and our Catalog No. 100-C.

BUY WAR BONDS NOW—SAVE FOR LATHES

SOUTH BEND LATHE WORKS

LATHE BUILDERS FOR 37 YEARS • SOUTH BEND 22, INDIANA

WE LOOK UP A MOMENT FROM OUR WORK

Seems a long time since we have thought in terms of civilian goods. How the subject flashed into our mind was baffling at first. Then we traced it back to the morning news. All that ground in France, in Belgium, that we expected would take months to conquer, taken in less than sixty days. And equally strong advances in the other theatres. Funny how the mind correlates and plans ahead.

A great new Drop Forging world awaits the day when production swings around to peacetime living. We thought we knew Drop Forgings before, but what a teacher this War has been. They told us we would have to do more with less. It didn't seem possible. We are doing it, though . . . finer results with lesser steels . . . closer forging limits . . . greater production with less man power . . . These are only a few of the insurmountables.

Yes, there is a great new Drop Forging world awaiting the word "Go!"

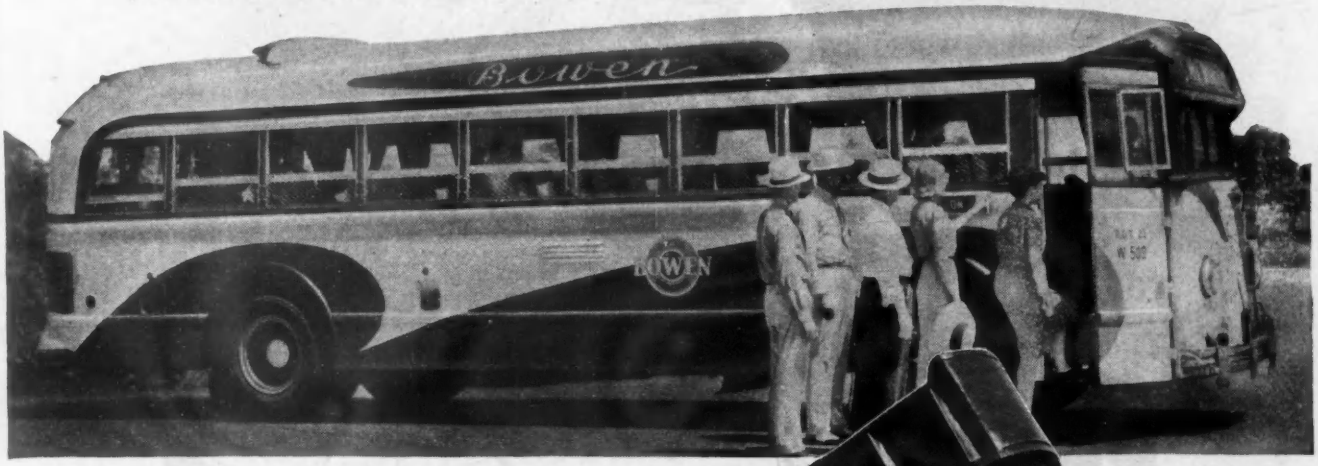
ATLAS DROP FORGE COMPANY
LANSING 2, MICHIGAN

IT IS A DUTY, AN HONOR
AND A SAFEGUARD TO BUY
UNITED STATES WAR BONDS

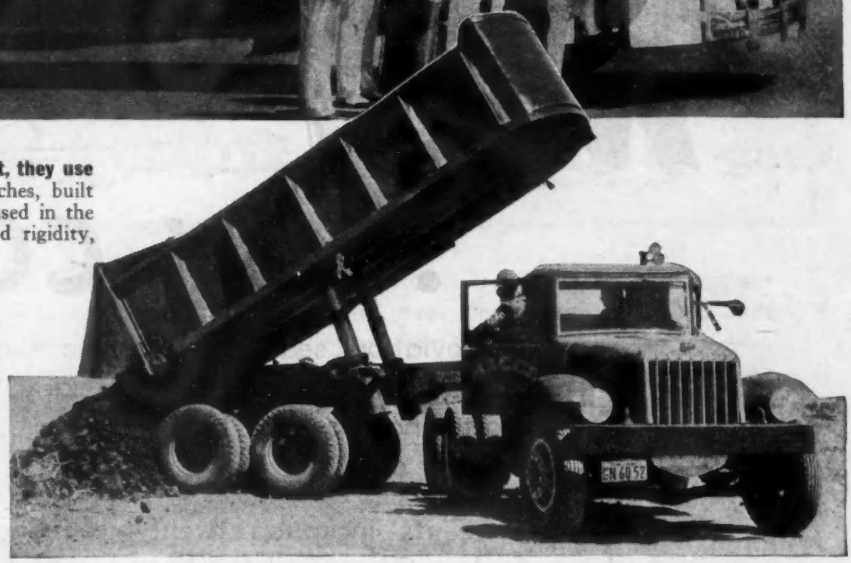
ATLAS DROP FORGINGS FOR WAR

The added *Safety* that only STEEL can give

(PLUS LIGHTWEIGHT TO INCREASE PAYLOAD CAPACITY AND LOWER COSTS)



Where they want strength with light weight, they use COR-TEN. In these 37-passenger motor coaches, built by the White Motor Company, COR-TEN used in the underframes insures maximum strength and rigidity, saves 200 pounds in weight.



1800 lbs. lighter, carries 1500 lbs. more payload. Using U·S·S COR-TEN in the bridge-truss type body frame, Fruehauf reduces weight 1800 lbs. under conventional construction. Unit is 33′ long, 8′ wide, 7′ high. When built, these trailers were the lightest of this type operated on the West Coast.

U·S·S COR-TEN the pioneer high strength, low-alloy steel is now available for the more efficient construction of buses, trucks and trailers.

Builders of such equipment need no introduction to COR-TEN. Ten years ago they found in COR-TEN the ideal material for the safe and low-cost reduction of deadweight. They proved in thousands of vehicles that COR-TEN increases safety, boosts payload capacity, helps to reduce the wear on tires and brakes, saves gasoline. That it makes repairs, when necessary, simpler and cheaper.

Used in the structural members of buses, the extra strength, the greater stamina and high resistance to impact that COR-TEN assures—without increase in weight—is low-cost, permanent "safety insurance" that operators were quick to appreciate.

In hardworking trucks and trailers, the weight saved and the ruggedness added by COR-TEN construction pays off in longer life, fewer breakdowns, and the ability to carry bigger loads further, for less money.

As you prepare to meet postwar competition—and it promises to be tough—plan to give your equipment the added safety and higher earning power that COR-TEN construction can insure. Our engineers will gladly guide you in its adaption to your designs.

U·S·S High Strength Steels

AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York*
CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
NATIONAL TUBE COMPANY, *Pittsburgh*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*
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UNITED STATES STEEL

. . BY COLD

An aviation sealing compound must be able to stand arctic or stratosphere cold without shrinking, cracking or crumbling. No matter how low the temperature drops, it must remain plastic and resilient always.

Since its inception twenty years ago, **TiteSeal** Gasket and Joint Sealing Compound has been in constant service in the coldest ends of the earth and has proven its cold resisting qualities in thousands of planes. Today it rides in practically every plane in the service.

TiteSeal is also heat-proof, pressure-tite, vibration-proof, non-hardening; and is impervious to all of the gases and liquids encountered in airplane motors and equipment.

TiteSeal is made in FIVE DENSITIES to meet every gasket and joint sealing need . . . from the most delicate to the most rugged For information about the many uses of **TiteSeal**, write

TiteSeal conquers cold.

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SPERRY EXACTOR REMOTE CONTROLS in use!

Positive control, through a single tube

The Sperry EXACTOR Hydraulic Remote Control is a simple, unique, single-tube system designed to control mechanisms over distances up to 200 feet. The more than 60,000 EXACTORS in operation today, solving the remote control requirements of design engineers in many fields, are proof of the thorough engineering and trouble-free design incorporated in this system.

It is accurate to a fraction of a degree and entirely self-contained, reproducing applied motion without the aid of an auxiliary source of power. It presents no installation problem, because both the Transmitter and Receiver are compact and light in weight, and the tube which connects them can be *bent around* obstacles easily. Vibration does not interfere with its positive, reliable action and means is provided for periodic temperature compensation.

If you have a remote control problem — in the railroad, marine, automotive, aviation, or any of the industrial fields — you will want our completely descriptive booklet. Send for it today.

The Sperry EXACTOR HYDRAULIC REMOTE CONTROL is rated at 400 inch-pounds in one direction, through 55° of motion, and 100 inch-pounds on the return.

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AAI—EHC-1044

SPERRY PRODUCTS, INC.
HOBOKEN • NEW JERSEY

Gentlemen: Please send me, at no cost, a copy of your Bulletin 78-D containing complete details on your EXACTOR HYDRAULIC REMOTE CONTROL.

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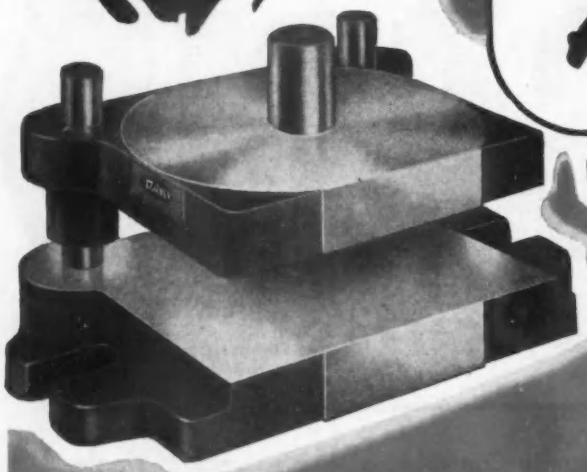
COMPANY.....

ADDRESS.....

CITY..... STATE.....

DANLY NATIONAL ASSEMBLY



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Precision finish of every part in Danly standard die sets makes possible Danly National Assembly. The resultant perfect fit saves you time and money through faster setups and longer, trouble-free operation.

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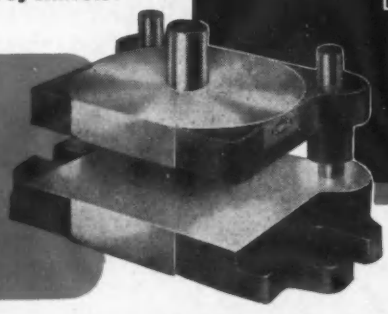

DIE MAKERS SUPPLIES • *Welded Steel Fabrication*

It's pleasant to dream about the family helicopter

. . . and some day soon it may be a reality

PEOPLE who should know claim that it will be years before the helicopter will be safe enough to join the auto in the public parking lot. But no one can tell when someone will bob up with a really foolproof helicopter that can be handled as easily and cost as little as the family car we're driving now.

We're intrigued, too, by other "dream products" that have been heralded as stepping stones to post-victory prosperity. We don't minimize their possibilities. But we believe the problems they present are still somewhat in the future.

Our big job now, as we see it, is to meet the needs of the portentous present and the *immediate* future by supplying superior products for airframe, engine and parts construction that will continue to make American planes the finest that fly.

In the new and continually better products we are developing in our research laboratories and manufacturing plants, the aircraft builder and designer will find an eminently practical answer to today's pressing requirements. By fine performance these products have truly earned their wings. They deserve serious consideration in your planning for tomorrow, be it ever so revolutionary.

Aircraft Products for the finer planes of Today and Tomorrow

Aircraft quality wire of every type—stitching wire for the faster, cheaper assembly of parts—hinge-pin wire, strut and tie wire, lock wire, cotter-pin wire—bright finished, tinned or galvanized wire in carbon, alloy and corrosion-resisting steels.

TIGER BRAND Control and Structural Cables that assure perfect functioning of controls.

Springs of all types and sizes—extension, compression and torsion springs—plane part springs, springs for precision instruments, new and special springs for the plane's fighting armament.

Cold Rolled Strip Steel to add strength to airframe and accessory construction.

Cold Finished Bars of aircraft quality steels, that make possible mass production of high precision parts.

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

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USS

UNITED STATES STEEL

MAHON

Built-for-the-Job

CLEANING AND COATING SYSTEM

specially developed for treating engine parts before shipment overseas . . .

Converts to a

MODERN FINISHING SYSTEM

for the Coming Peacetime Operation

Many Finishing and Processing Systems—engineered by Mahon for special war production purposes—now are being revised for peacetime operation—often with only slight change and at surprisingly little expense.

The Mahon engineering staff is cooperating with numerous manufacturers on transition problems. In preparing plans for adapting present equipment to the demands of rapidly approaching civilian production they are accomplishing some highly satisfactory results. Have a Mahon representative go over your equipment with you. You will find the advice and suggestions he is prepared to offer both practical and sound. Your switchover will be made speedily and smoothly—and at a minimum cost. You will have a production line that incorporates the most recent advances in efficient and economical Finishing equipment—insuring a faster, finer output.

THE R. C. MAHON COMPANY

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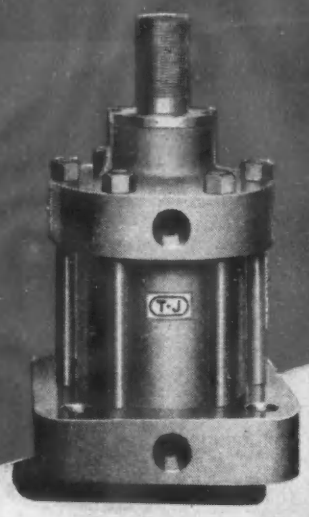
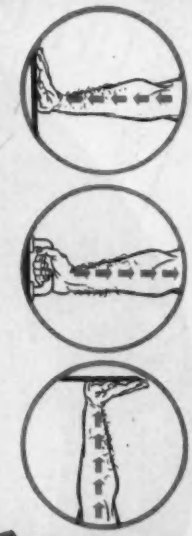
Manufacturers of Metal Cleaning Machines • Rust Proofing Machines • Hydro-Filter Spray Booths • Ovens of All Types • Filtered Air Supply Units • Hydro-Foam Dust Collectors—and Many Other Units of Special Production Equipment—including Complete Finishing Systems

MOVE "MOUNTAINS or MOLE HILLS"



IN ANY DIRECTION



Here's *efficient power movement* to help you get maximum speed in your production... use T-J Air and Hydraulic Cylinders! Apply a T-J Cylinder to eliminate muscular effort or to simplify mechanical movements—the ideal way to clamp, press, raise or shift in any direction! Built in many styles, sizes and strokes to meet your requirements... exerting power movement of 100 lbs. to 12,000 lbs. (direct) with T-J Air Cylinders... 1000 lbs. to 50,000 lbs. (direct) with T-J Hydraulic Cylinders. Easily and quickly installed. Write for latest catalogs.

FOR TOUGH JOBS SPECIFY

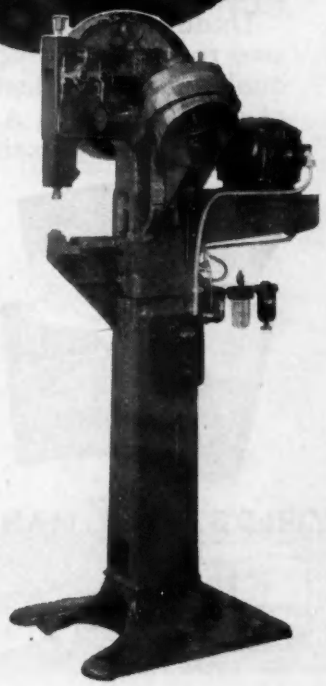
TOMKINS-JOHNSON

RIVITORS AIR AND HYDRAULIC CYLINDERS CUTTERS CLINCHORS

T-J

SET CLINCH NUTS

3 to 5 times faster



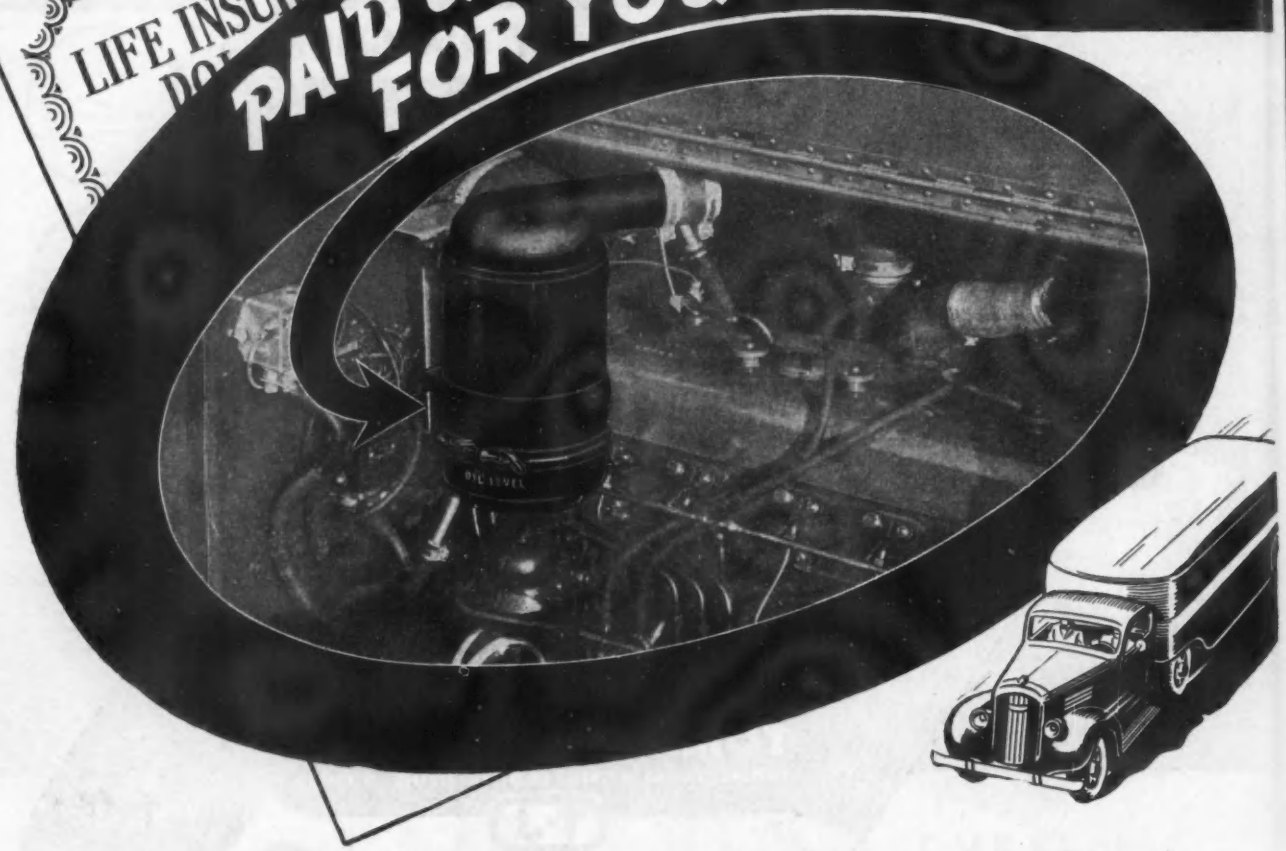
The T-J Clinchor greatly steps up production in setting clinch nuts—and keeps spoilage to a minimum.

Today's rapidly increasing use of clinch nuts in the production of automotive parts and other products has created a demand for a machine to automatically feed and set these nuts with speed and accuracy. The Clinchor meets these demands completely. Not an attachment for a punch press, it is a fully automatic machine, controlled by a single foot pedal.

Rapid in operation—this machine's output is limited only by the speed with which the operator can feed the work to the machine. Write for catalog.

The Tomkins-Johnson Company, Jackson, Michigan.

PAID UP LIFE INSURANCE FOR YOUR ENGINES



Bus and truck engines equipped with Donaldson Oil-Washed Air Cleaners and Donaldson Positive Crankcase Ventilation are insured against wear from dust and grit . . . for their lifetime.

Under most operating conditions abrasive road dust is engine enemy number one! But with a dust removal efficiency of close to 100%, a Donaldson installation is an impassable barrier for this ever-present, air-borne engine destroyer.

Donaldson protection against dust and grit is engine insurance that pays big dividends in continued operating efficiency and longer engine life . . . lower cost per mile. In terms of your business it means satisfied users and consequent greater sales.

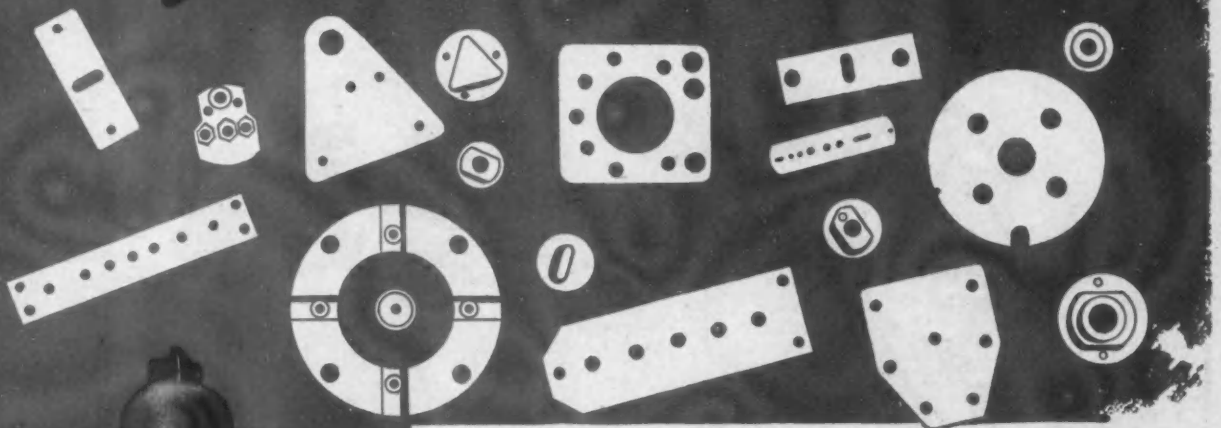
DONALDSON COMPANY, INC.
666 PELHAM BOULEVARD SAINT PAUL 4, MINNESOTA

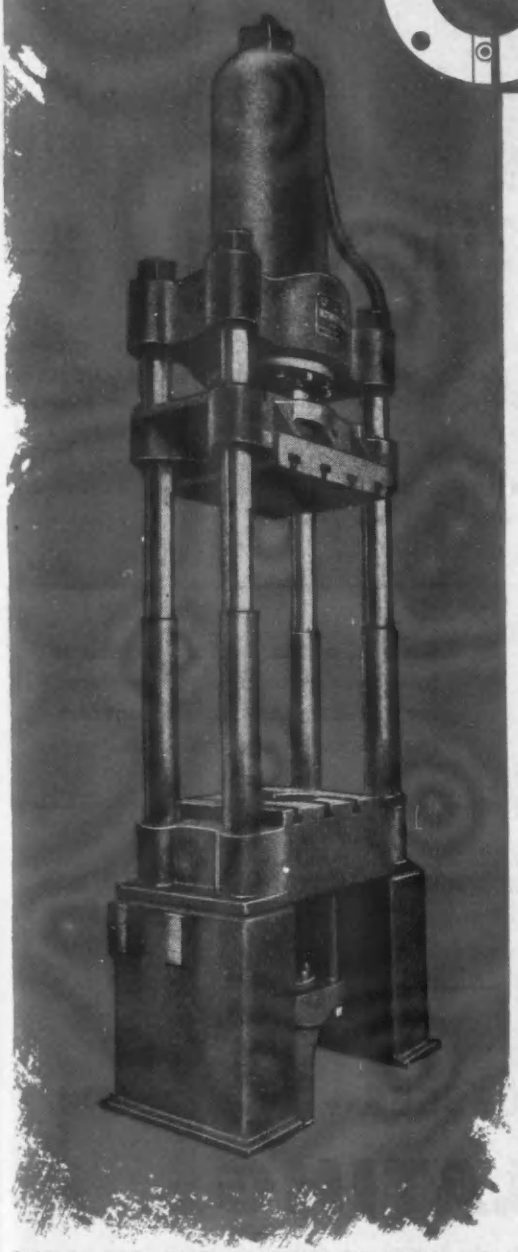
The Donaldson engineering staff has the longest record of service in the industry. This experience is available to you for consultation on your dust problems . . whether they be of design and installation or of maintenance.

DONALDSON
Oil-Washed
AIR CLEANERS

WORLD'S FIRST MANUFACTURER OF AIR CLEANERS

Want Fast Production of Pressed Steatite Parts?





USE W-S DOWN-ACTING PRESSES

There's a Watson-Stillman cold-molding press for any type of molding where steatite or other ceramic materials are used. Made in capacities from 10 to 100 tons, these machines enable you to get fast production of a wide variety of tubes and solids. They are self-contained, of the down-acting type, with radial type pump driven by a motor to suit the machine's capacity. As a safety factor, the main cylinder is controlled by a valve so that both hands of the operator will be out of the press when valve is operated. On smaller presses, a mechanical stripper is provided; on the larger presses, a hydraulic ejector strips the mold.

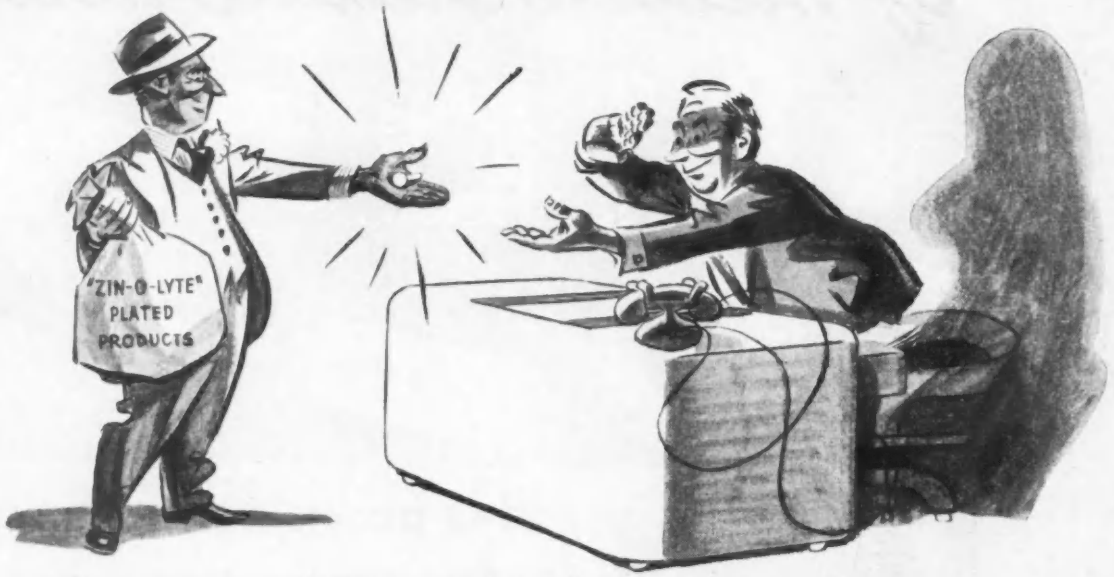
Advances in research and application of steatite products make these machines valuable assets to plant production of small parts by the cold molding process.

Send for your copy of the new Watson-Stillman bulletin which illustrates and describes these efficient cold-molding presses. Ask for Bulletin 650-A. The Watson-Stillman Company, Roselle, New Jersey.

WATSON-STILLMAN

DESIGNERS AND MANUFACTURERS OF HYDRAULIC EQUIPMENT, FORGED STEEL FITTINGS AND VALVES

BRILLIANT ZINC DEPOSITS WITHOUT BRIGHT DIPPING



Du Pont "Zin-O-Lyte" Zinc Plating

Distinctive, brilliant blue-white zinc deposits closely resembling chromium, are produced directly from the "Zin-O-Lyte" plating bath and *without bright dipping!* In both still and barrel plating, consistent production of very bright deposits without a bright dip is an important essential for practical, economical operation.

"Zin-O-Lyte" solutions are easily made up from prepared salts. Two addition agents used in the process are extremely effective in producing brilliant deposits. One of them also increases current efficiency and widens the bright current density range.

The "Zin-O-Lyte" plating bath may be operated either at high or low current densities with slight changes in composition or operating temperatures—adaptable to individual plant requirements. It can be used for almost all types of ferrous base metals.

The "Zin-O-Lyte" Operating Manual gives complete details about the Du Pont "Zin-O-Lyte" process, tells how it can be used for production of brilliant, low-cost rust-resistant zinc deposits. Send for a copy. E. I. du Pont de Nemours & Co. (Inc.), Electroplating Division, Wilmington 98, Delaware.

Call At
Booth C-110
National Metal Congress
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Drop in at the Du Pont Exhibit to talk over your plating problems, for information about Du Pont plating processes and materials.

Great stars in great radio plays make great entertainment . . . tune in "Cavalcade of America"—NBC Network—every Monday evening

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DU PONT CHEMICALS • PROCESSES • SERVICE

for ELECTROPLATING

Better Things for Better Living . . . *Through Chemistry*

FLEX-O-TUBE *Detachable* HOSE FITTINGS

CHOSEN FOR
REPLACEMENT
ON ALL
MILITARY VEHICLES
A complete assortment of replacement patented hose fittings packaged in the type of kit here illustrated and Style No. 7530 hose lines are furnished by Flex-O-Tube to all supply units all over the globe for use on the fuel and oil lines of all U. S. administrative and tactical vehicles (buses, cars, trucks, jeepers, ambulances, etc.).
They are being used from the steaming jungles of Burma to the frozen tundra of the Aleutians, and for use with all types of fuel including aromatic fuels.
Total production now being used by the armed forces — will later be available when the military situation permits.
FLEXIBLE HOSE and ATTACHABLE, RE-USABLE COUPLINGS
MAKE-UP SPECIFICATION MANUAL

THE **Flex-O-Tube** COMPANY

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Whatever the grinding purpose may be, ABRASIVE COMPANY GRINDING WHEELS deliver Top Flight Performance. If you're looking for *improved* results in uniformity, economy and longer wheel life . . . if your job, or jobs, are listed below . . . then we cordially invite you to investigate ABRASIVE COMPANY PRODUCTS. Write for FREE Data Book—120 pages of interesting information on modern grinding.

Wheels, Discs, Segments, Grain, Mounted Points for

Internal Grinding	Cylindrical Grinding	Surfacing
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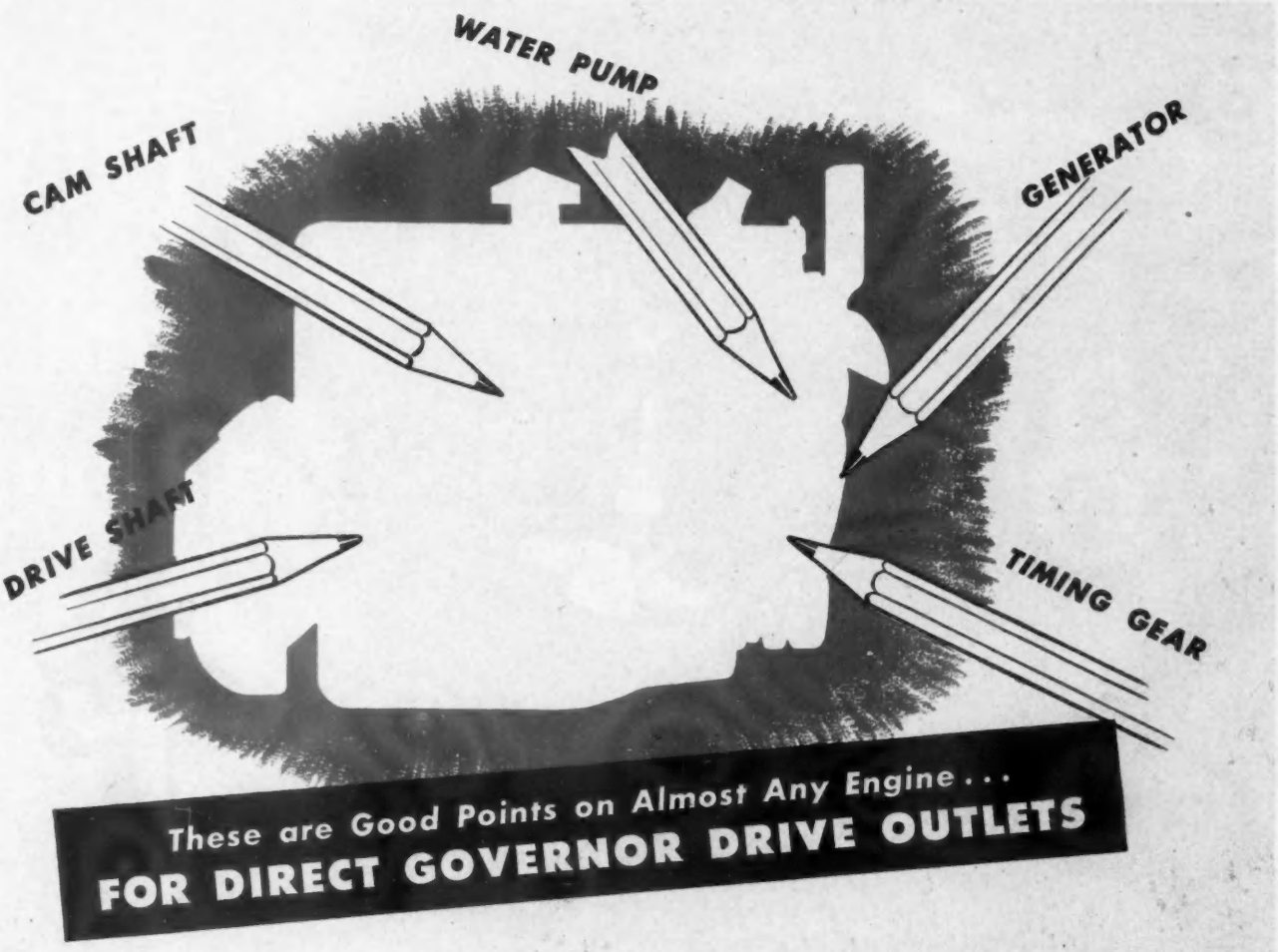


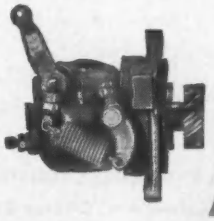
These are Good Points on Almost Any Engine . . .
FOR DIRECT GOVERNOR DRIVE OUTLETS

● There are several good points on almost every internal combustion engine where provision could be made for direct driving of positive, instantly responsive *mechanical* governors.

And an increasing number of internal combustion engines are getting into industrial and automotive applications in which close, dependable governing is acutely desirable.

The operator's preference is for the extra efficiency and longer trouble-free service of a gear-driven governor. But despite this preference, Pierce still is receiving many orders every month for the belt-driven universal type governor—mute evidence to the fact that many popularly used engines make no provision for gearing the governor directly.

It's easy to design direct drive outlets on your engines and meet this preference. Pierce engineers, with a wealth of experience in solving governor problems, are always available for the advice or assistance in design which you may wish.

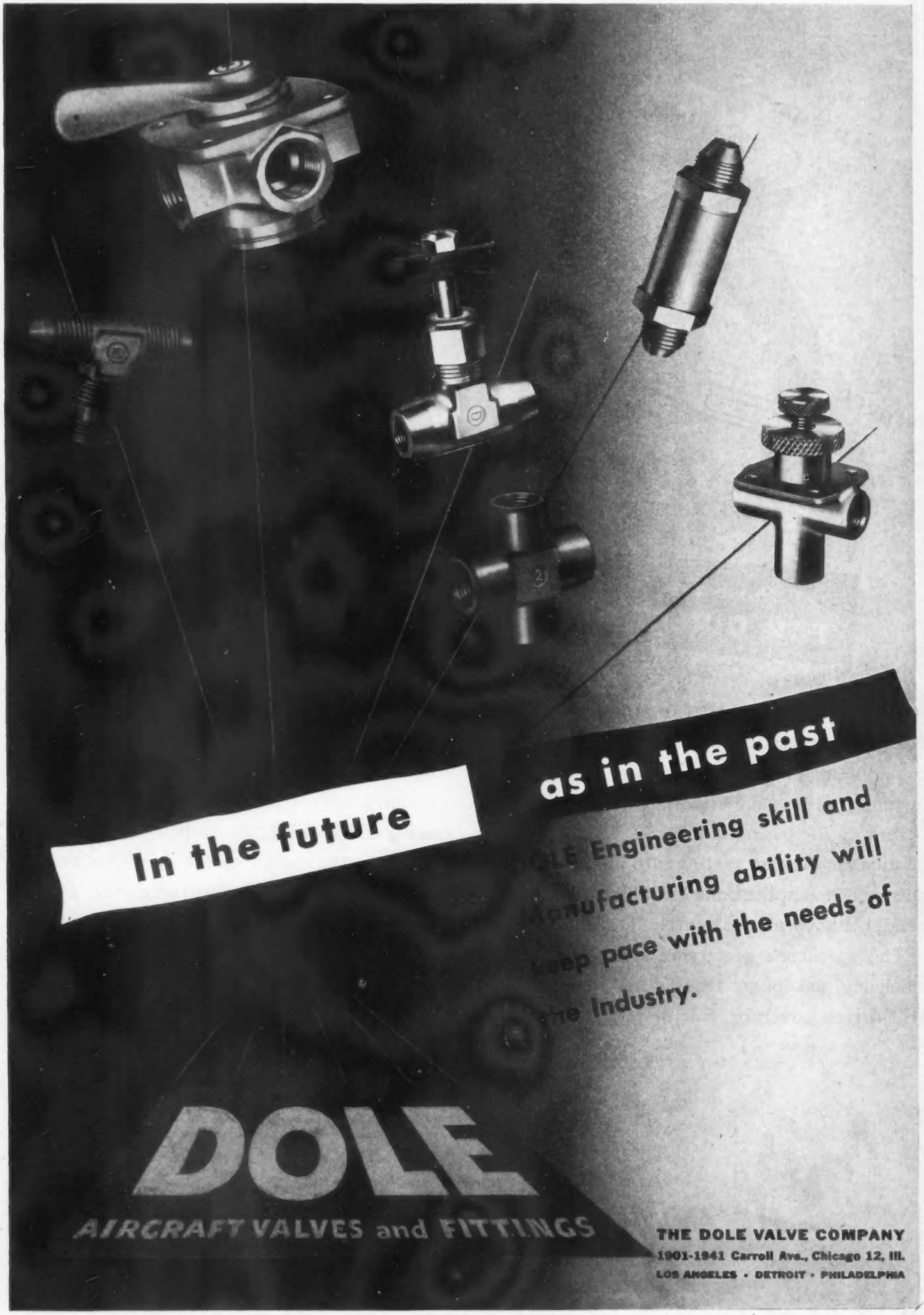


THE PIERCE GOVERNOR COMPANY, INC. • 1637 OHIO AVENUE • ANDERSON, INDIANA

Manufacturers of Pierce Precision Governors and Sisson Automatic Chokes

Canadian Manufacturer and Distributor: BURLEC LIMITED, Toronto 13, Canada

PIERCE GOVERNORS


In the future
as in the past
DOLE Engineering skill and
Manufacturing ability will
keep pace with the needs of
the Industry.
DOLE
AIRCRAFT VALVES and FITTINGS
THE DOLE VALVE COMPANY
1901-1941 Carroll Ave., Chicago 12, Ill.
LOS ANGELES • DETROIT • PHILADELPHIA

PAINT ADHESION PROBLEMS

SOLVED BY THIS NEW OAKITE DEVELOPMENT

OAKITE CRYSCOAT PROCESS

TRADE MARK REG. U.S. PAT. OFF.

A low-cost cleaning and chemical conditioning treatment for ferrous metal parts and surfaces that inhibits rust and successfully provides the essential surface grippage for tenacious adhesion of organic finishes.

Extensively used on many types of war matériel, this specially designed wartime Oakite process has a wide application on an almost unlimited variety of iron and steel peace-time products to which paint and similar finishes are applied. Because it so effectively helps to keep production costs low, ask us to send you the interesting details on how you can inexpensively CrysCoat your product and solve the problem of paint adhesion.

FREE SERVICE REPORT GIVES YOU DETAILS

This 4-page Service Report describes how Oakite CrysCoat No. 86, an integral part of the Oakite CrysCoat Process, in ONE time-saving operation (1) removes light oils, grease, shop dirt and other foreign matter; (2) inhibits surfaces against rusting while parts are being held for painting; (3) imparts a microscopic crystalline coating to ferrous surfaces that assures TENACIOUS GRIPPAGE of paint or other organic finishes.

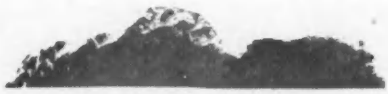
Oakité CrysCoat No. 86 is a NEW, acid-type detergent, SAFE to product itself and SAFE to washing equipment in which it is used. If you are experiencing trouble and are getting rejects due to paint adhesion failure, this Oakite Service Report will give you a war-tested, successful answer to this problem. Send for your FREE copy today!

OAKITE PRODUCTS, INC., 28A Thames St., New York 6, N. Y.

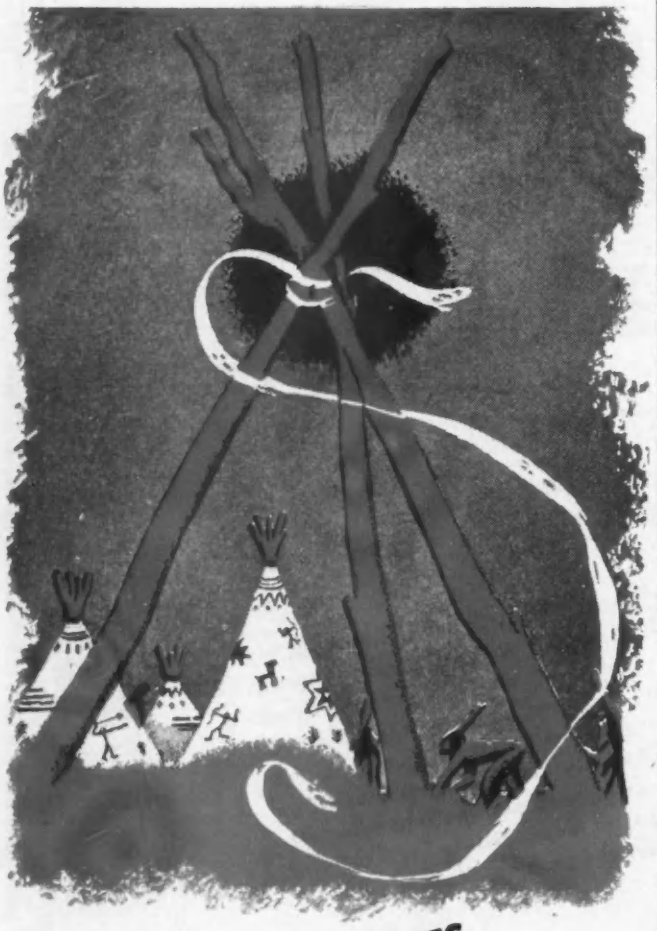
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE MATERIALS...METHODS...SERVICE

CLEANING FOR EVERY CLEANING REQUIREMENT



teepees were tied with thongs...



BUT NEW PRODUCTS NEED NEW FASTENINGS

With keen competition that must follow the first rush of peacetime business, important details will influence sales, promote merchandising, stimulate success. Of these, a major item is fastenings. America's new products will be efficient, economical, accessible.

Camloc engineers showed plane manufacturers that easily operated doors and removable panels can be secure at 400 M.P.H. They are ready to design special fastenings for your product and your budget.

CAMLOC

CAMLOC FASTENER CORPORATION

Copr. 1944 Camloc Fastener Corporation

420 LEXINGTON AVENUE, NEW YORK 17, N. Y.

GROOMED FOR TOUGH MISSIONS

• Upstairs, when the going gets tough, depend on Kester Cored Solders to stand the gaff. Heat, cold, vibration, shock, bending—none of these affect a Kester soldering job. That's because Kester alloys and fluxes are free from impurities which cause soldering failures. Fluxes are scientifically compounded and self-contained in the core of the solder. Alloy and flux, in perfect balance, are applied in one simple operation—assuring a tight, clean, *permanent* union.

• Use Kester Acid-Core Solder for all general applications; Kester Rosin-Core Solder for electrical work. Both are available in a wide range of core and strand sizes.

• If you are uncertain which Kester Solder combination is right for your shop operations, consult Kester engineers. There is no obligation.

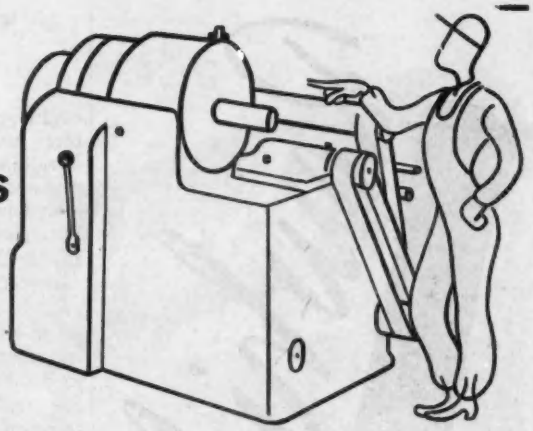
☆ BUY WAR BONDS ☆

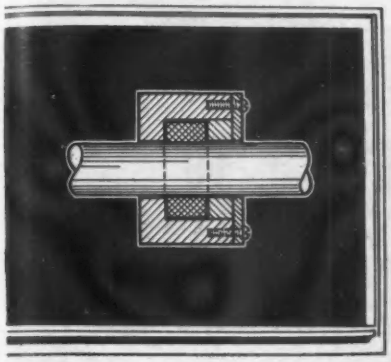
KESTER SOLDER COMPANY
4202 Wrightwood Ave., Chicago 39, Illinois
Eastern Plant: Newark, N. J.
Canadian Plant: Brantford, Ont.

Finest Quality FOR 45 YEARS 1899-1944 KESTER SOLDER

KESTER Cored Solders
STANDARD FOR INDUSTRY

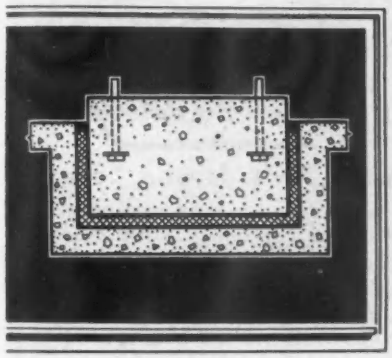
Felters Felt Protects Machine Parts





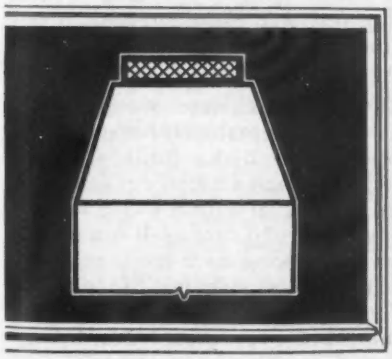
it excludes dirt, grit, dust

Felters Felt keeps bearings running true, with a consequent gain in accuracy; guards against loss of lubricants resulting from bearing wear. Low maintenance cost.



it absorbs vibration

Because it is highly resilient, with a predictable permanent set; will not deteriorate with age or exposure to water, oil, gasoline or acid in normal concentrations, Felters Felt is ideal as the medium for increasing the accuracy of machine settings, reducing maintenance and fatigue problems arising from transmitted vibration.



it is a lubricant feeder

Because of its wicking action, Felters Felt may be used to conduct lubricants from reservoirs to points of application. Highly resilient, it maintains close contact with an extreme minimum of friction. Many other uses for the felt that cuts without fraying are described in "Felt as a Design Material", a copy of which may be obtained by writing to The Felters Company, 210 R South Street, Boston, Massachusetts.

_____ put in your post-war picture

The best "soft" hammers and mallets are rawhide—tough, resilient, long-lasting C/R mechanical rawhide. They strike effective blows without battering or marring . . . without fatiguing re-coil. They hold their true striking surfaces. Sizes and weights for every need. Hammers are malleable iron with replaceable C/R Rawhide insert faces.

Write for Catalog Sheets.

CHICAGO Rawhide MFG. CO.
1310 ELSTON AVE. ★ CHICAGO, ILLINOIS.

SAE T&M Meeting

(*Continued from page* 80)

could be eliminated. New ignition systems using electronic tubes are being developed which may eliminate the present high tension secondary leads. These new systems use low tension distribution and step up the voltage at the spark plug.

Spark plugs are being developed rather rapidly and there is progress with electrodes made of platinum and tungsten; some using thorium are now in production. These metals and alloys are used to increase the emissivity, i.e., to more easily surround the points with electrons so that the spark might jump across the gap with a lesser impressed voltage. The mechanical design of the plug is also being improved.

Bearing materials have been improved tremendously in the past few years under the stress of aircraft development. Bearing manufacturers are aiming and seem to be fairly confident of obtaining bearings that will handle loads of more than 2000 psi with the present relative margin between actual and manufacturers' ratings. Aluminum bearings seem to be potentially capable of rapid development. Silver bearings offer quite a bit in load carrying capacity and it is stated that they will permit extended life of the crankshaft. New methods of manufacture including the plating process may considerably reduce the final cost of a silver bearing and if it can be used for greater mileages it will certainly be acceptable. The art and knowledge of plating bearings has progressed rapidly during the war. Special platings of 0.0005 in. on a bearing can apparently make all the difference between one which will run 100,000 miles or more, and failure in a few thousand miles, indicating that texture of the finish as well as compatability of the metals can be a big factor in increasing bearing capacity and life. To date, lead and indium have been the metals most often used in the plating of commercial bearings.

Carburetors are being improved, in order to give more accurate and constant mixture ratios with better atomization in order to facilitate more even distribution among the cylinders. This might be accomplished by adapting some of the characteristics of today's aircraft engine injection carburetion.

Injection carburetion leads to the possibilities in injection. This may resolve itself into direct, manifold or port injection and appears to offer many possible advantages.

Diesel Goes to War

By J. H. Moloney, Advertising Manager, Detroit Diesel Engine Division, General Motors Corp.

As a result of the expansion and development of the Diesel industry in this country, the United States quickly surpassed European countries in the practical application of Diesel units.

Watch Dog
REG. U.S. PAT. OFF.

Lasts Five Times Longer

One reason why maintenance men are replacing with General Electric's popular Watch Dogs is because of their unusually long life. Under specified test conditions the FS-40 outlasts an average of ten 40-watt lamps, the FS-100 . . . eight 100-watt lamps. The G-E Watch Dog *lasts five times longer* than ordinary fluorescent starters.

Reason For Its Long Life

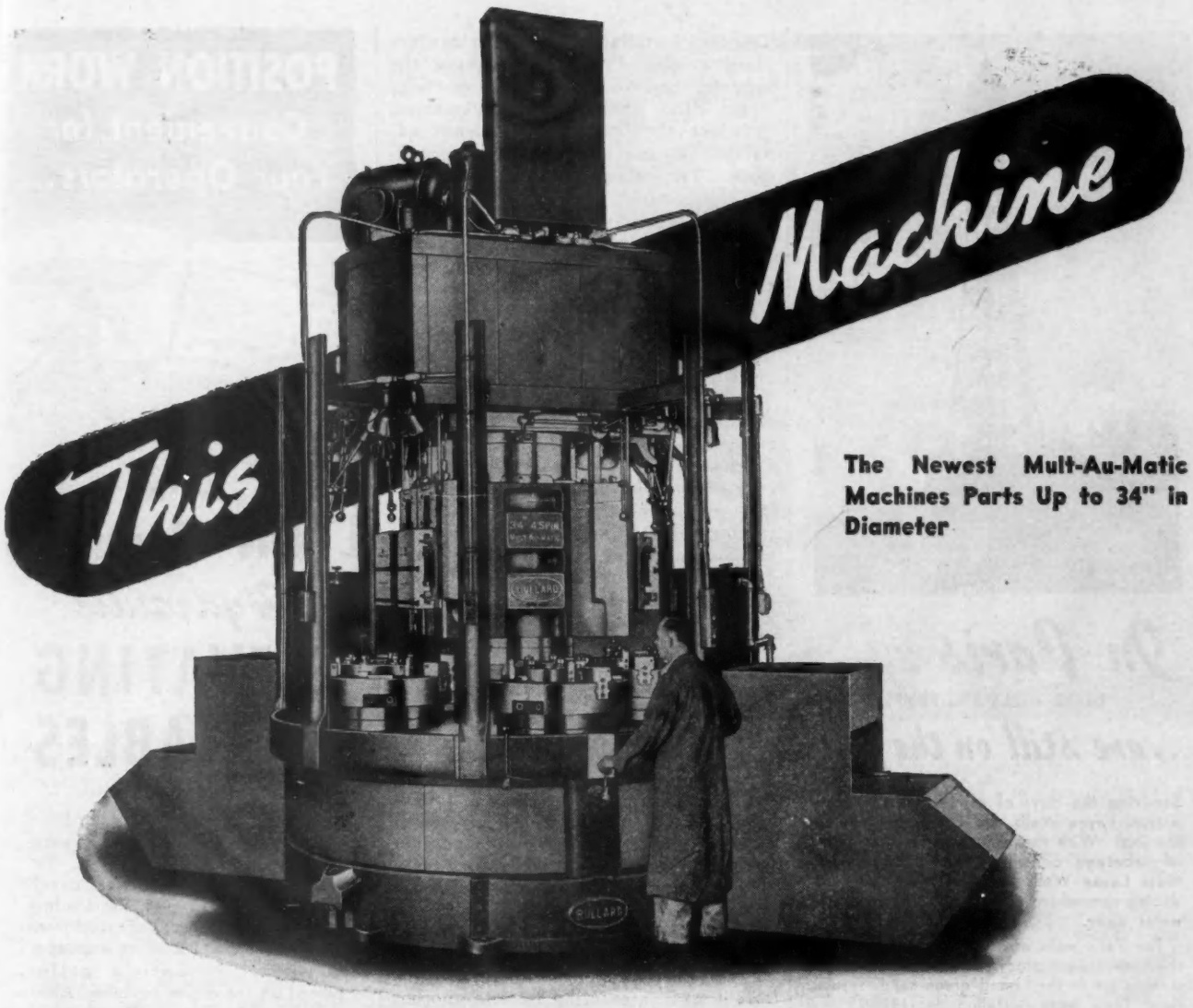
Ordinary starters wear themselves out prematurely because they continue to make futile starting attempts when a lamp begins to die. This is not so with the G-E Watch Dog because it cuts itself out of the circuit as soon as a lamp reaches the end of its useful life. Since there is no flow of current, burned-out lamps are prevented from being started needlessly and the Watch Dog's life is greatly prolonged.

Hear the General Electric radio programs: "The G-E All Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news every weekday 6:45 P.M. CBS.

BUY WAR BONDS AND KEEP THEM

For additional information write to Section G1041-103, Appliance and Merchandise Dept., General Electric Company, Bridgeport, Conn.

GENERAL ELECTRIC



The Newest Mult-Au-Matic Machines Parts Up to 34" in Diameter

MAKES PRODUCTION HISTORY

Here, in the 34" Mult-Au-Matic, is the long-awaited Bullard answer to the need for extending mass production economy to the manufacture of the larger mechanical parts. This new machine handles parts with diameters as large as 34", heights up to 23."

Think what that means. On scores of operations on smaller parts, the regular Type "D" Mult-Au-Matics have made substantial cuts on production times for the automotive, aviation and similar industries. Now you can apply these same economies to your larger, heavier work as well. For the 34" Mult-Au-Matic offers the same unique advantages:

1. Compound tooling — completes a piece of work in the time required for the longest single cut.
2. Simplified tooling — enables an unskilled worker to operate the machine.

The 34" machine has 4 stations. But since each of the 3 working stations has 2 heads, it accomplishes work formerly done by 6 stations.

Write to-day for booklet — 34 MAM TR — giving complete specifications. Better still, send us blueprints of your work tor a time estimate.

Note These Features

Capacity: 34" Swing for a maximum of 23" above top of spindle.

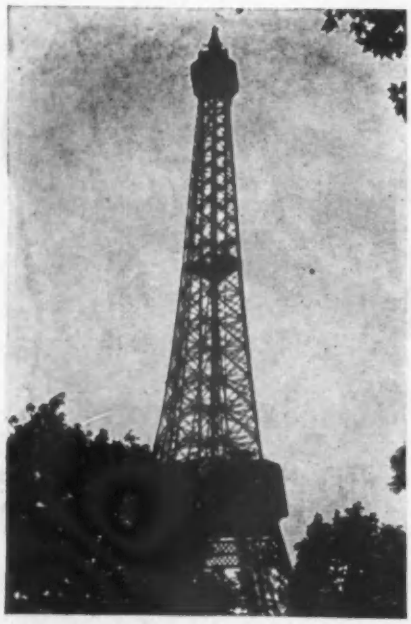
6 heads — 2 at each working station, each with independent feed works, and each providing vertical, horizontal or angular motion.

Adjustable column: permits moving all six tool heads up and down, eliminates tool overhang, increases tool rigidity.

Power operated chucking standard equipment.

THE BULLARD COMPANY

BRIDGEPORT 2, CONNECTICUT



In Paris . . .

LAYNE WELLS AND PUMPS

. . are still on the job!

Surviving the days of ruthless enemy occupation, Layne Wells and Pumps are still on the job! With the exception of some cases of sabotage or wilful enemy destruction, those Layne Wells and Pumps are still producing somewhere near 90,000,000 gallons of water daily.

The Paris wells are 3,000 feet deep, with their corrosive proof, Layne built shutter screens set in the famed green sands formation. They were installed in 1928-29 by Layne-France Company, one of Layne's many affiliated companies. The city officials of Paris, after thorough investigation, selected Layne Wells and Pumps from a field of the keenest world-wide competition. Their confidence in the equipment has been more than justified.

Today in liberated Paris, rebuilding is already under way, but little or no work will be required to keep Layne Wells and Pumps spinning merrily along and producing ample quantities of water.

Layne Well Water Systems have also made great records in other war zones; Dakar, Tunis, Casa Blanca and London. They have long lasting quality that more than amply fits them for any peace-time need.

For late literature, address Layne & Bowler, Inc., General Offices, Memphis 8, Tennessee.

AFFILIATED COMPANIES: Layne-Arkansas Co., Stuttgart, Ark. ★ Layne-Atlantic Co., Norfolk, Va. ★ Layne-Central Co., Memphis, Tenn. ★ Layne-Northern Co., Mishawaka, Ind. ★ Layne-Louisiana Co., Lake Charles, La. ★ Louisiana Well Co., Monroe, La. ★ Layne-New York Co., New York City ★ Layne-Northwest Co., Milwaukee, Wis. ★ Layne-Ohio Co., Columbus, Ohio ★ Layne-Texas Co., Houston, Texas ★ Layne-Western Co., Kansas City, Mo. ★ Layne-Western Co. of Minnesota, Minneapolis, Minn. ★ International Water Supply Ltd., London, Ontario, Canada

LAYNE

WELL WATER SYSTEMS

DEEP WELL PUMPS

The two installations of American engines which did the most to spur the industry on to increased proportions were: First, the American submarine, in which the United States Navy expanded its use of the two-cycle principle. The other dramatic event was the appearance of the world's first Diesel powered streamlined train. Before long Diesels were finding a full measure of work to do on farms, highways, and on scores of peacetime construction projects.

With the mass production way of making Diesel power plants, in the most efficient manner, already in existence, stepping up to meet the needs of war was in effect a matter of increasing production facilities. The early English tanks were among the first war applications in which this product was to prove its worth. Then in military tractors—better known in this war as bulldozers. They were used in small landing craft such as the LCVP (Landing Craft Vehicle Personnel) powered by one six-cylinder engine and in the LCM (Landing Craft, Mechanized) powered by two six-cylinder units, and the LCT (Landing Craft, Tank) by three units. Each unit had its own propeller shaft. One or more units could be operated as desired. Engines used to propel these boats had a prewar rating of about 165 hp each, and have been supplied to the Armed Forces at ratings up to 225 hp. The same engines develop over 300 hp in laboratory tests. The coupling of two basic six-cylinder engines together by means of a transfer case to deliver the double power to a single driveshaft comprises the "Twin" Series 71 engines.

It is also interesting to note another development. It has been found possible to inject gasoline in the exact same manner as Diesel fuel; that is, into a 16 to 1 compression ratio. As a matter of fact, when the gasoline is injected into the hot air of the combustion space, ignition of the gasoline takes place slower than when Diesel fuel is injected. Experimental Ordnance vehicles have been constructed with two fuel tanks, one containing Diesel fuel, and the other gasoline, so the Diesel engine could operate on either gasoline or Diesel fuel. The economy in the consumption of gasoline, using it this way

Classified Advertisements

TECHNICAL ASSISTANT—Familiar with automotive engine construction and repair. Former service manager or junior engineer able to handle specification data and service bulletins for essential parts manufacturer. Detail your experience, vital statistics and income requirements. Statement of availability required. Box 52, Automotive and Aviation Industries.

WANTED: Men familiar with fuel and lubricant application in automotive fleets. Maintenance experience desirable. Give complete description of experience. Statement of Availability required. Box 55, Chilton Company, 56th & Chestnut Streets, Philadelphia 39, Pa.

POSITION WORK
Convenient for Your Operators...

Standard stock models have many uses. Write for literature.

WITH

LYON-Raymond

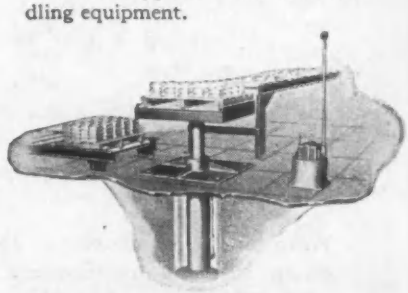
Hydraulic

ELEVATING TABLES

SPECIAL MODELS to Meet Specific Requirements

For example—a special elevating table (illus. below) was developed for loading pigs of metal from a roller conveyor onto a pallet placed on the elevating table. After each tier is in place, table is lowered to the proper height to permit *easy, safe* transfer of the heavy metal. Finally the full pallet load is rolled onto an outgoing conveyor located flush with the table in its lowest position.

To answer your problems of positioning work to the most convenient and safe height for the operator, LYON-Raymond engineers are prepared to recommend applications or design special models of their numerous types of material handling equipment.



LYON-Raymond Corporation

380 Madison St., Greene, N. Y.

Ever stop to think? . . .

why fighting equipment deals out greater destruction today—lasts longer—takes more punishment? It's due to a lot of things—American initiative, ingenuity—and sometimes just plain dissatisfaction and inquisitiveness. Take simple things like springs.

★ ★ ★

The range of performance has been increased greatly in recent years, but in spite of that, spring failure is practically unknown—certainly unnecessary. It's the result of a combination of scientific methods and practical experience—in materials, design, heat-treatment and tests.

★ ★ ★

The range is greater—because the inquisitiveness of Gibson craftsmen is never satisfied. If you, too, are raising your sights for better mechanical action—

USE GIBSON SPRINGS

The William D. Gibson Company

DIVISION OF ASSOCIATED SPRING CORPORATION

1800 Clybourn Ave., Chicago 14, Illinois

PEERLESS UTILITY FOR MISCELLANEOUS METAL SAWING!

THIS low-priced UTILITY Metal Cutting Saw sets new standards of value in power-driven metal sawing machines. It's made for wet or dry cutting — is motor or belt driven — has capacity of 4½" x 4½".

Cutting stops automatically at end of cut or at any gauge-set point. Sensitive spring and cam type feed mechanism compensates for varying hardness of materials. Feed pressures are adjusted by hand screw. Heavy one-piece base and frame insures straight cutting and long life with sustained accuracy.

Why hack away by hand when you can save time, materials and manpower with the low-priced Peerless UTILITY?

Mail the coupon for Bulletin D.C. 54. If you're doing tool and die work you'll also want Bulletin 53 on the famous Peerless Vertical Metal Sawing Machine.

PEERLESS
MACHINE COMPANY
MACHINE WISCONSIN

Dept. AA-10-44

- ☐ Rush Bulletin D.C. 54 on Peerless UTILITY Metal Cutting Saw. Also send following Peerless Bulletins:
- ☐ Bulletin MC-51 on new MECHANI-CUT Saw.
- ☐ Bulletin 53 on Peerless Vertical Saw.
- ☐ Bulletin HC-50 on Peerless Hydra-Cut.
- ☐ Bulletins on Stock Rests, Blades and Coolant.

Company .....

Name .....

Street Address .....

City ..... State .....

in the Diesel cylinders compared with the normal carburetor engine: 10 miles per gallon being the consumption with the carburetor engine, 14 with gasoline injected into the Diesel cylinder, and 16 with the straight Diesel engine.

The development of multiple engines did not end with the "twin." The larger type of invasion craft required engines of still greater power. The result was the "quad"—which is four 6-cylinder engines all coupled together delivering power to a single driveshaft for use in the LCI(L) Landing Craft Infantry. Eight six-cylinder Diesels arranged as two "quads," drive her two propellers. Each "quad" develops 900 horsepower and has its own gear box, propeller shaft, propeller, and variable pitch control. The weight is about 12.5 pounds per horsepower developed.

Here is the list of just those uses of Diesels we are permitted to mention: submarines and submarine mother ships; SC subchasers; 131 and 171-foot PC subchasers; DE destroyer escorts; minesweepers; rescue vessels; tankers; diving tenders; landing boats and barges; tank and cargo lighters; dredges; tank and tank destroyers; tractors and bulldozers; shovels; stand-by and portable generator sets; dock compressors; lighthouse service; buses and trucks.

Some of you may feel you would like me to tell you when we will have Diesel engines in automobiles. Well, engineers do not yet have that answer.

C-F POSITIONERS

"Position" Counts Most in this heavy duty Welding Operation

Production welding usually means working on top, bottom and on all sides of the weldment. It means a "quick change" of position should be possible for greater time saving, more efficiency, lower costs and greater safety to men and materials. With C-F positioners a welder can quickly position even the most cumbersome weldments at the press of a button, without crane help or handling crews. With just one set-up of the weldment he can position it easily, speedily and safely, all alone. He can rotate it a full 360° at variable speeds from 0 R.P.M. up, tilt it to 135° beyond horizontal, and can weld, down-hand, all sides, surfaces and angles in the one set-up with larger rods and fewer passes. All C-F positioners, both stationary and portable, are pedestal mounted to give maximum floor and working clearance and all are adjustable for height.

Write for Bulletin WP-22

CULLEN-FRIESTEDT CO.

1322 S. Kilbourn Ave. Chicago 23, Ill.

AUTOMOTIVE and AVIATION INDUSTRIES EQUIPMENT by "SILENT HOIST"

KRANE KAR

Our 26th year

1918-1944

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TRIPOD POLE DERRICKS

THE ORIGINAL SWING BOOM MOBILE CRANE WITH FRONT-WHEEL DRIVE AND REAR-WHEEL STEER

Self-stabilizing; no outriggers or jacks. Gasoline or Diesel. Solid or pneumatic tires. 11 to 35 ft. booms.

"SILENT HOIST" TRUCK EQUIPMENT

DELIVERIES with an AA-5 or Higher Priority

WINCHES AND POLE DERRICKS — 30 TO 60 DAYS

SWING BOOM TRUCK CRANES — 60 TO 90 DAYS

TYPICAL USERS: Boeing; Lockheed; TVA; AT&T; N. Y. Tel.; Pennsylvania R. R.

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2½, 5, AND 10 TON CAPACITIES

KRANE KAR

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After The Others Failed

SpeedWay's "know how" was able to develop new gearmotor designs for the Armed Forces that did the required job. Today, expanded needs for these motors take SpeedWay's capacity, as well as the capacities of other large motor manufacturers, *working to SpeedWay Specifications.*

If you need motors or gearmotors for a standard or special application, bring your problem to SpeedWay. Motor outputs range from 1/3000 to 1/3 h.p. Unlimited gear ratios available from stock gears. Write for our recommendations on your war or postwar problem.

Write for SpeedWay's new Motor Bulletin showing standard A.C., D.C., and Universal Motors and gearmotors.

SPEEDWAY MFG. CO. 1872 S. 52nd Ave., Cicero 50, Ill.

BETTER MACHINE TOOLS = GREATER PRODUCTIVITY
GREATER PRODUCTIVITY = INCREASED PROSPERITY

SIBLEY
MACHINE & FOUNDRY CORPORATION
SOUTH BEND 23, INDIANA

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"PRECISION ...THAT'S MB"

SUB-CONTRACTS FOR THE MANUFACTURE OF HIGH-PRECISION PRODUCTS

This Company, with 2 modern factories, and 1,300 employees, at present engaged in the most exacting type of high-precision war production, is interested in sub-contracts for the manufacture of products or units requiring high-precision skill. Will also consider outright purchase of new inventions and products or royalty basis.

ARMY E NAVY

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THE MB MANUFACTURING COMPANY, INC.
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ROLLIN METTLER, *President*

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EXPERIENCE
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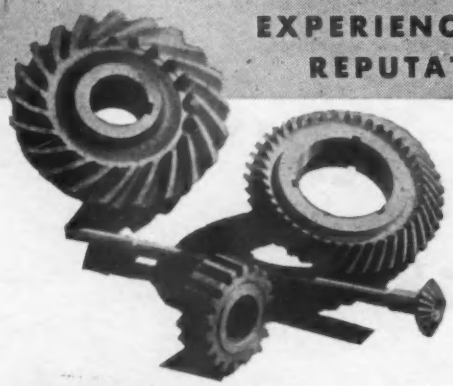

GEARS

There are always good reasons behind superiority—and this holds particularly true in the making of gears. Fairfield's gear processing and engineering services have behind them the accumulated knowledge and skill of more than 25 years of experience in making gears for leading manufacturers and complete, modern plant facilities for making and testing gears. Consultation with Fairfield on any and all gear problems brings immediate dividends in satisfaction.

FAIRFIELD MANUFACTURING CO.

ARMY E NAVY

319 S. Earl Avenue, Lafayette, Ind.

FAIRFIELD For FINE GEARS

G&O
Radiators
29th Year

AUTOMOTIVE and AVIATION

ENGINE COOLING RADIATORS

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OIL COOLERS

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THE G&O MANUFACTURING CO.

NEW HAVEN CONNECTICUT

ORTHO-HELIX
CONTROLLED DIRECTION OF FORCE
SPRINGS

● ORTHO-Helix Springs have set new standards of excellence in accurately controlling the direction of force. Ortho-Helix Springs seat valves evenly and eliminate uneven wear on valve guides and valve stems. A demonstration test with a Helixometer will prove their extra value.

Your inquiry is invited.

American Coil Spring Co.
MUSKEGON, MICHIGAN

HARDNESS TESTING

The STANDARD SCLEROSCOPE (Now highly Improved) for more than twenty years has made good and is still used for doing the world's hard work in testing. In general use for specifications purposes. Simple, Sturdy, Comparatively Inexpensive. Illustrated bulletins free. FOR QUALITATIVE AND QUANTITATIVE HARDNESS MEASUREMENT, under Static Pressure, the MONOTRON is the only machine now available. Operative up to over 2000 Diamond Brinell. Avoids errors due to spring in test pieces. Takes readings with the load on, avoiding reversal lash errors. No setting to zero. Operates at highest Speed. Has solved many old laboratory and shop problems. *We also make the Durometer for testing the hardness of rubber.* Comprehensive bulletins free.

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Van Wyck Ave. and Carll St., Jamaica, New York, N. Y.
Agents in all Foreign Countries

UNIT
3-AXLE MOBILE CRANE
for Heavy Duty LIFTING
Powerful UNIT 1020, mounted on a husky 3-axle under carriage, supplies maximum lifting ability. Features include: Hydraulic steering — air brakes — disc clutches — enclosed cast gear case—easy, one-man operation.

UNIVERSAL UNIT MACHINERY CORP., Milwaukee 14, Wis., U. S. A.

A RUNNING START

for

Post-War Hurdles

After this war is won, there are still going to be plenty of hurdles for business men to clear.

And clearing them in stride will best be accomplished from a running start, such as consistent advertising in AUTOMOTIVE *and Aviation* INDUSTRIES will help to provide.

The time to make such preparations, of course, is now.

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and Aviation
INDUSTRIES

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ONE DEPENDABLE SOURCE FOR ALL YOUR FASTENERS
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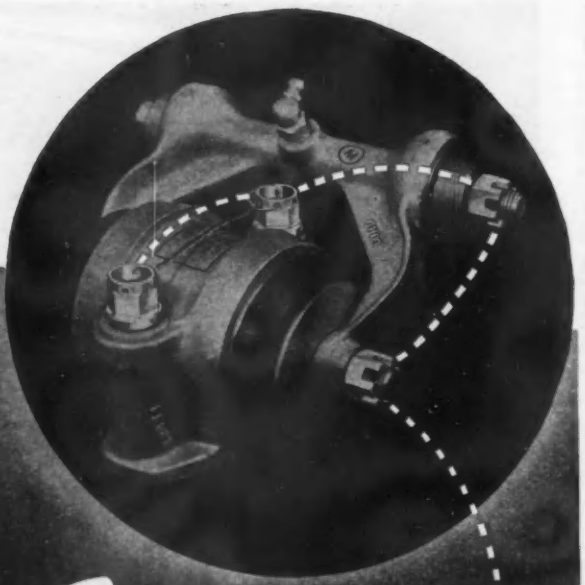

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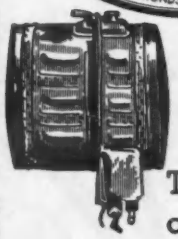

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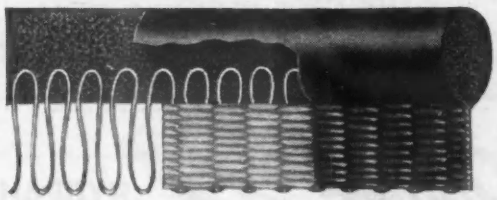

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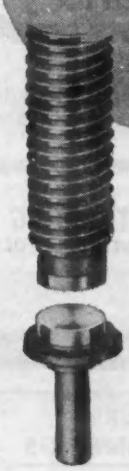

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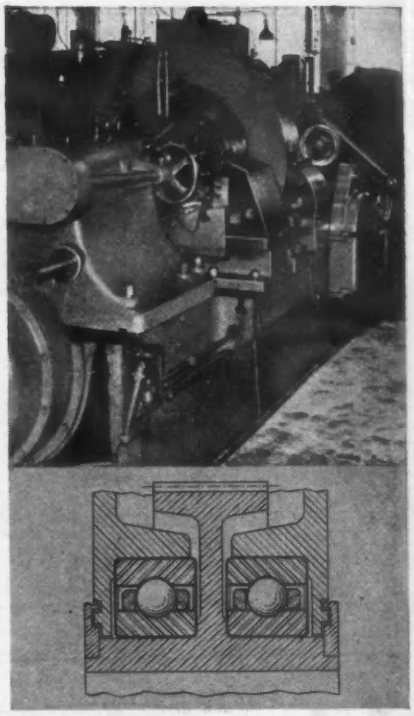
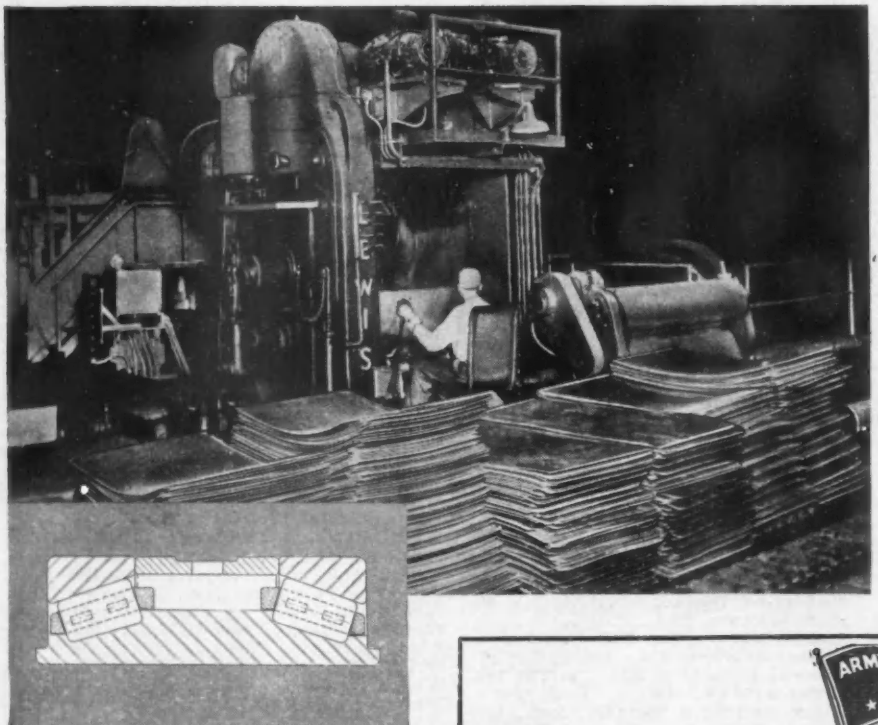
IN THE NEWS
WITH TORRINGTON BEARINGS

OFFICIAL PHOTO U. S. AIR FORCES

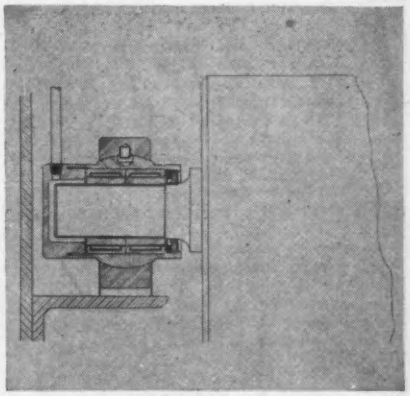
FLYING OVER 100 MILES AN HOUR this Army pilot of a Douglas B-23 tow plane is about to pick-up a 15-place glider. As the tow plane comes in, the arm of a pick-up device, manufactured by All American Aircraft, Inc., is lowered to catch the suspended tow line shown in the foreground. Torrington Ball Thrust Bearings were specified for installation in the mechanism of the pick-up, because of their capacity to withstand the severe and sudden shock loads encountered in the operation.



TURNING CRANKSHAFTS to precision limits is the important operation performed by this machine tool manufactured by the Hall Scott Motor Car Company. Due to high loads encountered in the center drive assembly, engineers specified the installation of two Torrington Ball Radial Bearings, as shown in the accompanying cross-section. The bearings have an outside diameter of 34″; an inside diameter of 27″, and are 3½″ wide.



THIS THREE-HI ROUGHING BREAKDOWN SHEET MILL, built by Lewis Foundry & Machine, is equipped with two-row tapered roller bearings, supplied by Torrington's Bantam Bearings Division, as shown in the accompanying cross-section. With each row employing 34 rollers, 1⅞″ long and 1-3/32″ in diameter, these bearings have a radial load capacity of 216,200 pounds; a thrust load capacity of 148,900 pounds at 100 R.P.M.



SUBMERGED in a bonderizing solution, the specially designed NCS Needle Bearings, shown in the accompanying cross-section, are sealed in a leak-tight housing equipped with a compressed air line to prevent the solution from reaching the bearing during operation. This is another example of Torrington's ability to adapt Needle Bearings to unusual applications. If you need counsel on standard or custom-built bearings, TURN TO TORRINGTON.

ARMY E NAVY

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